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VOLUME XXXVIII NO. 200 SEPTEMBER-OCTOBER 1953

LEWIS L. STRAUSS
Chairman
Atomic Energy
Commission

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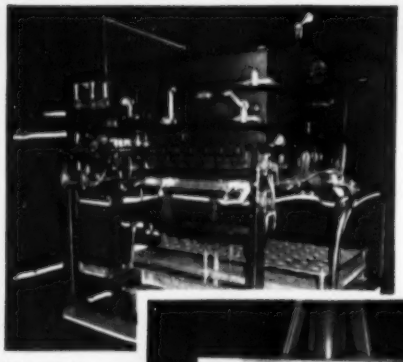
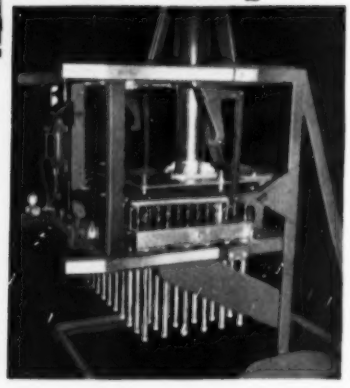


Volumetric Pouring Unit



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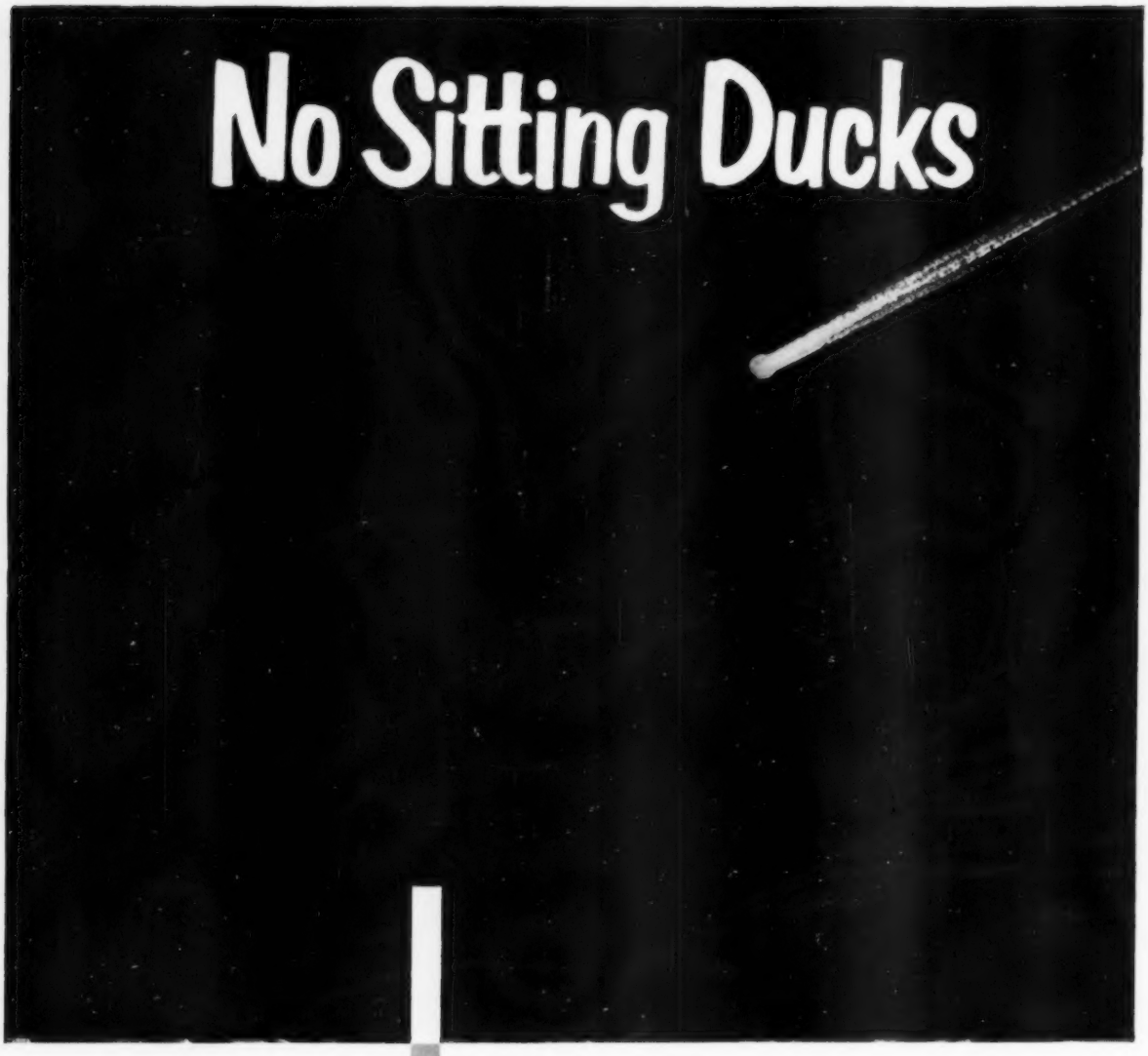

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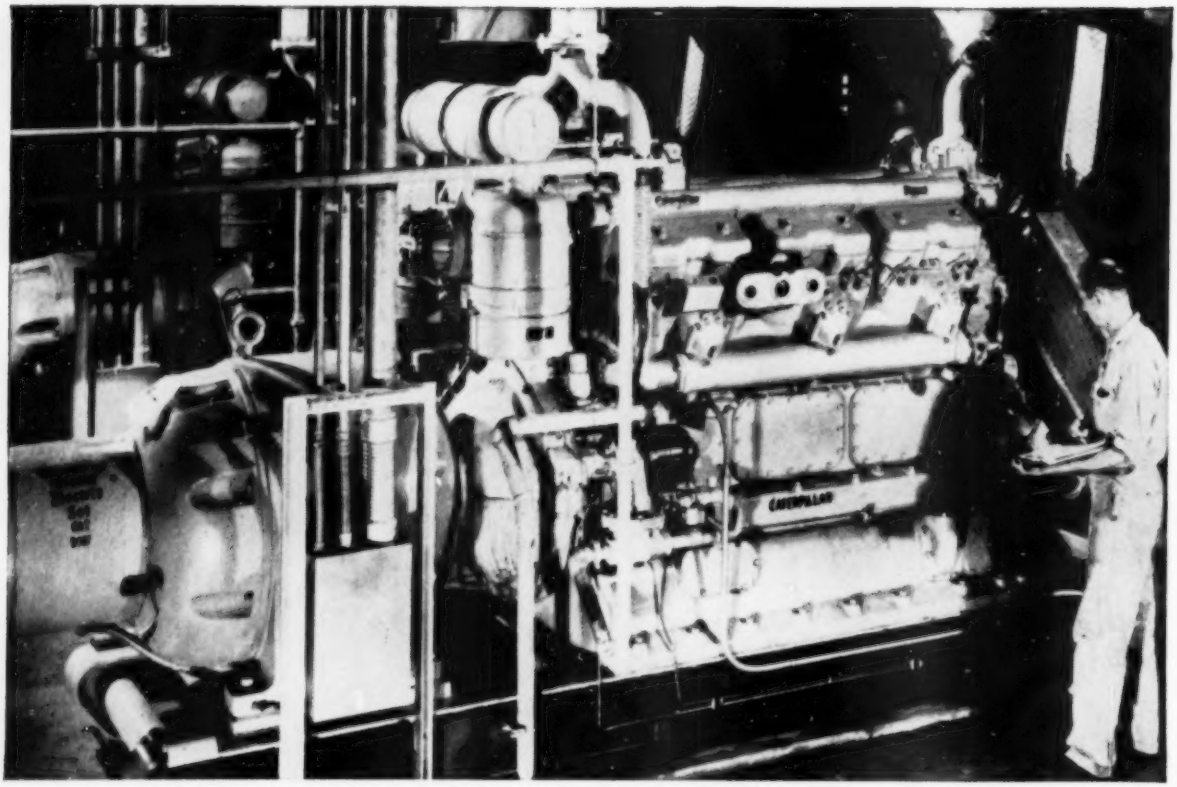

ATOMIC ENERGY PLANT: Two of ten Caterpillar D397 Diesel Electric Sets on duty at an Oak Ridge project. Background of photo has been touched out for security reasons. Like all Caterpillar Diesels, these big engines deliver full power, or idle without fouling, on low-cost, non-premium fuel.

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AT ATOMIC ENERGY PLANT AND GUIDED MISSILE STATION

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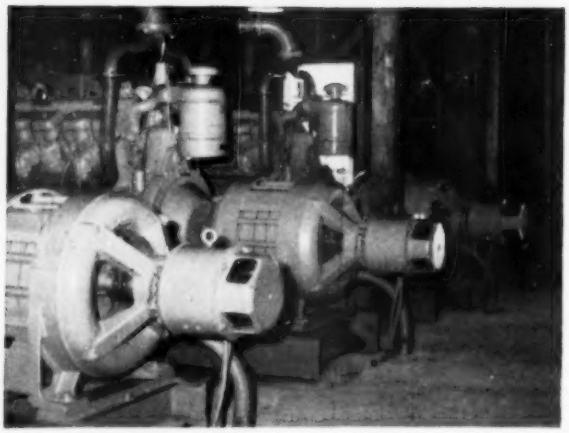

GUIDED MISSILE TRACKING STATION: Here are three of the four Cat D364 Electric Sets furnishing power for transmission and reception for USAF installation on Grand Bahama island in the Caribbean.

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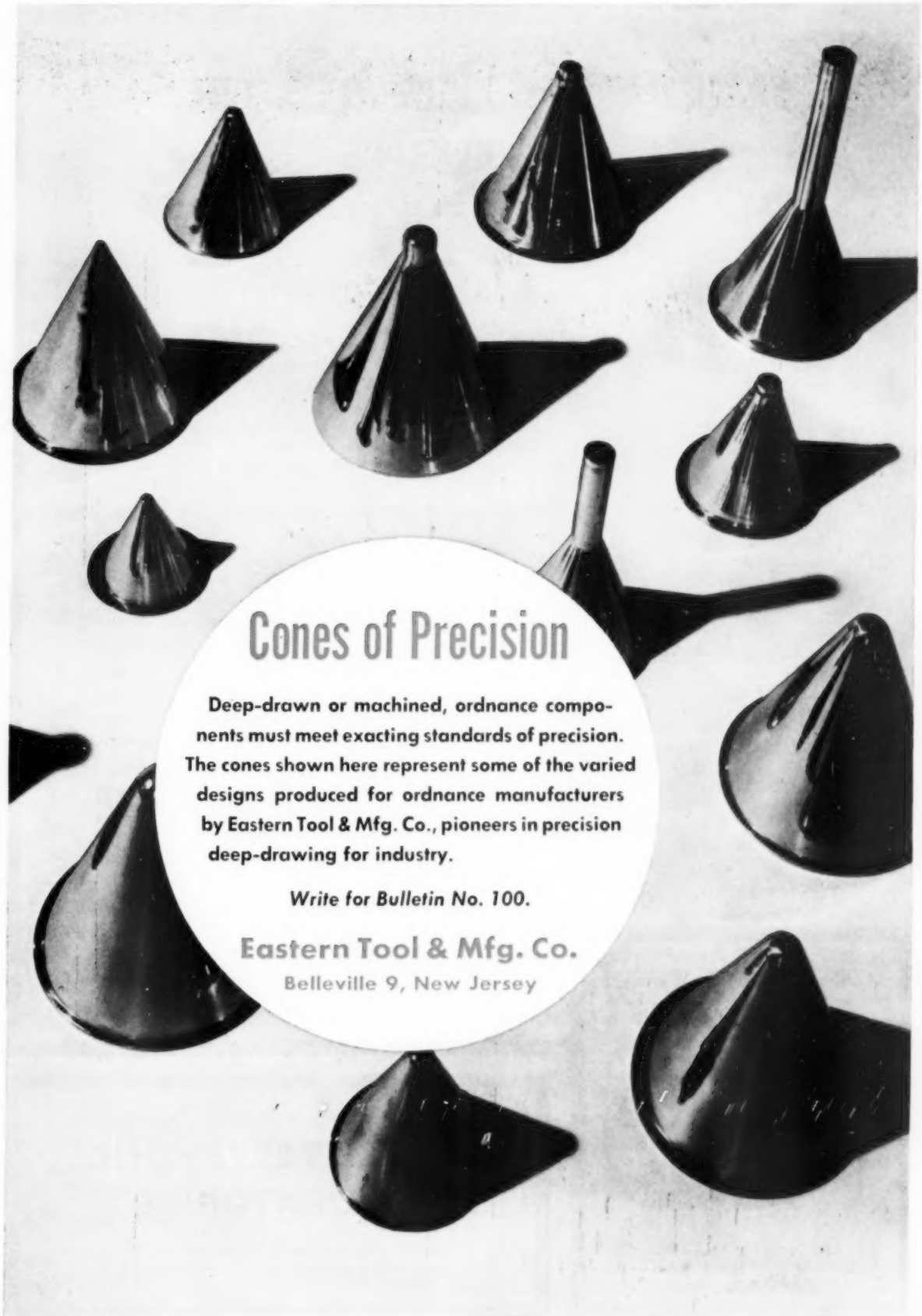
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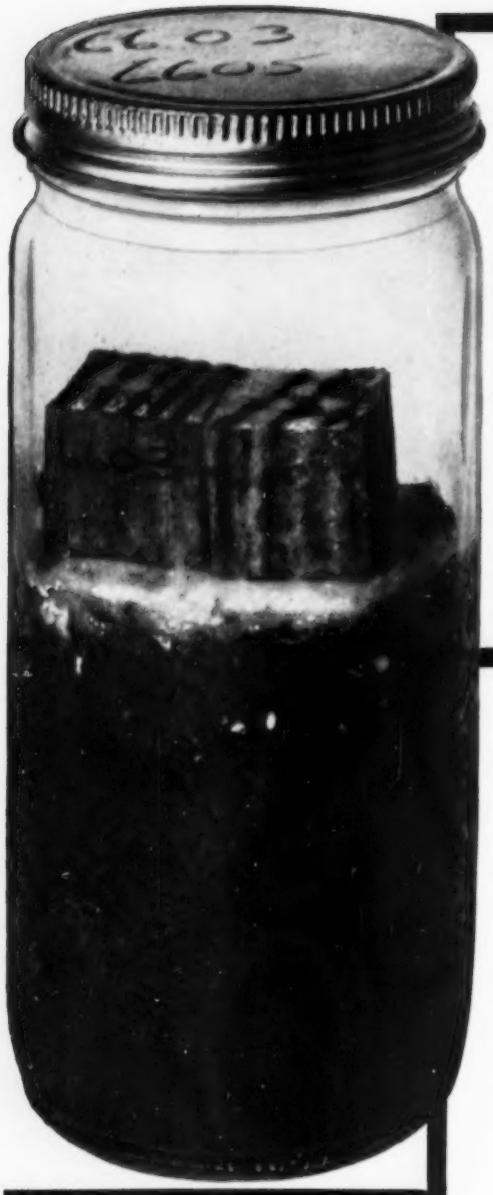

THIS BOTTLE TURNS SEVEN YEARS INTO SEVEN MONTHS

Test blocks of pole wood are fed to destructive fungi in bottles like this at Bell Laboratories. Wood rests on soil which controls moisture conditions and promotes fungus growth. Test speeds search for better preservatives.

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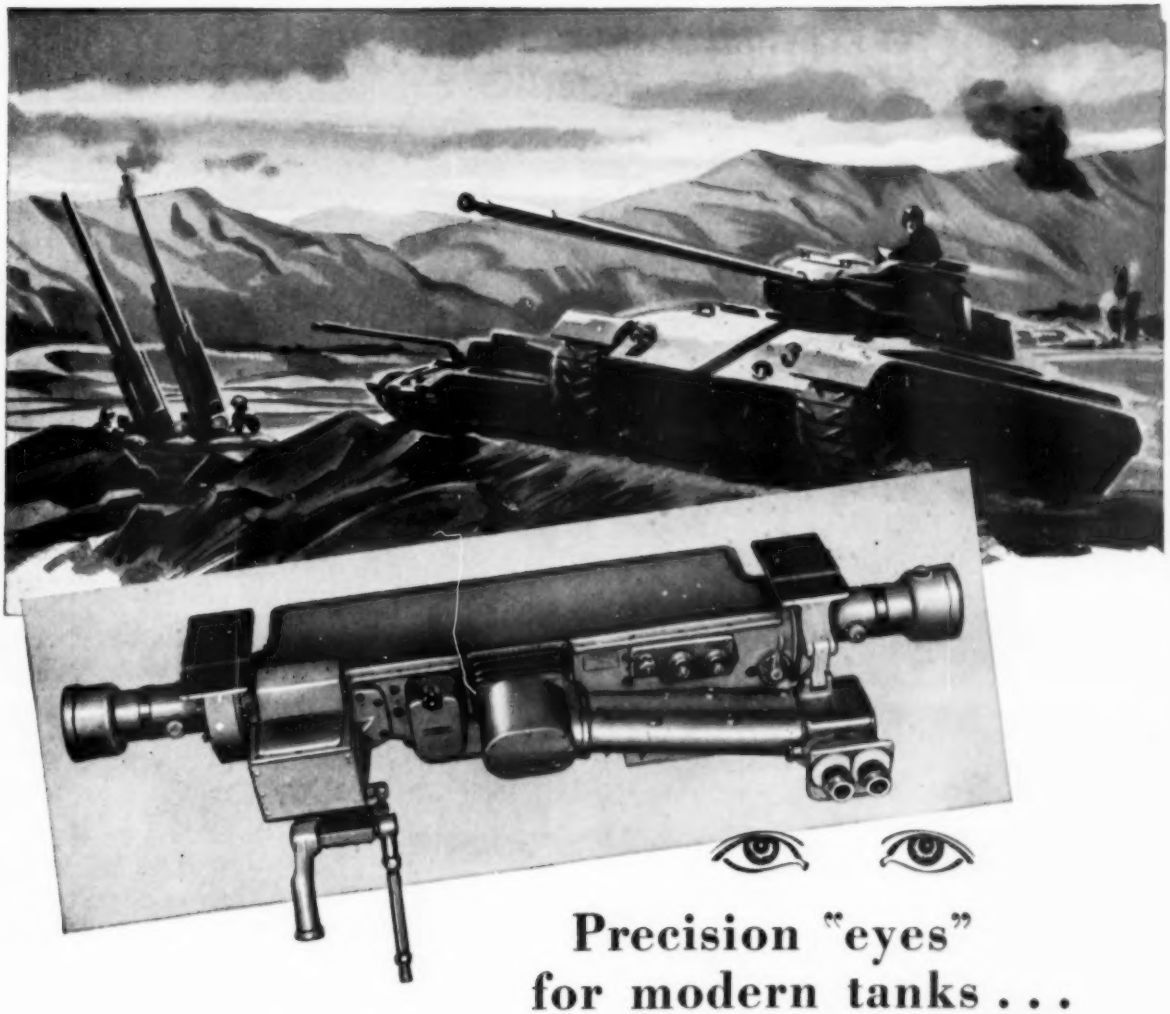

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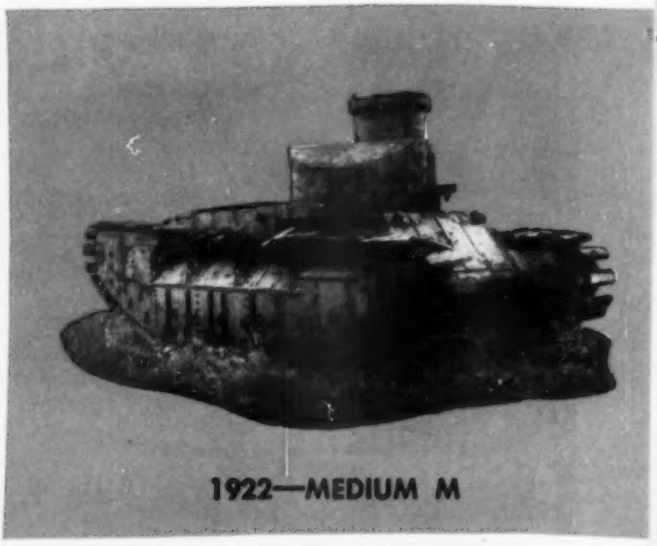

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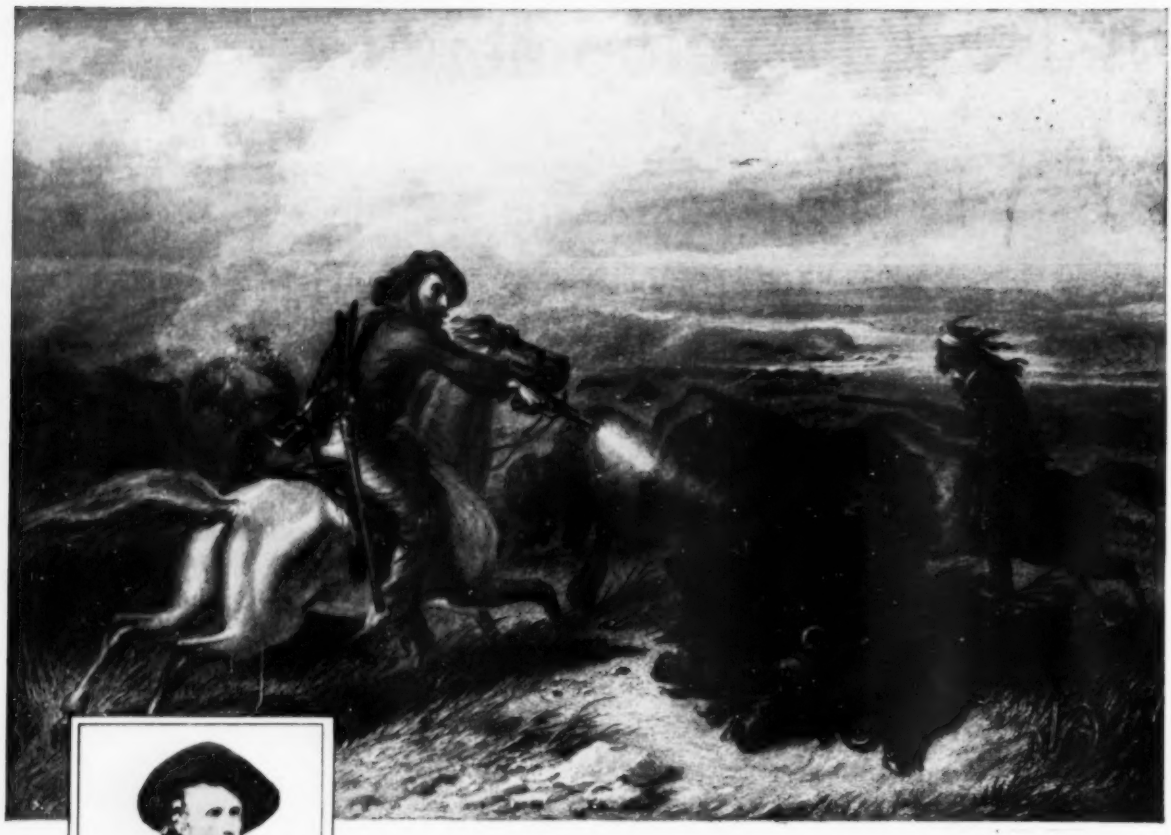

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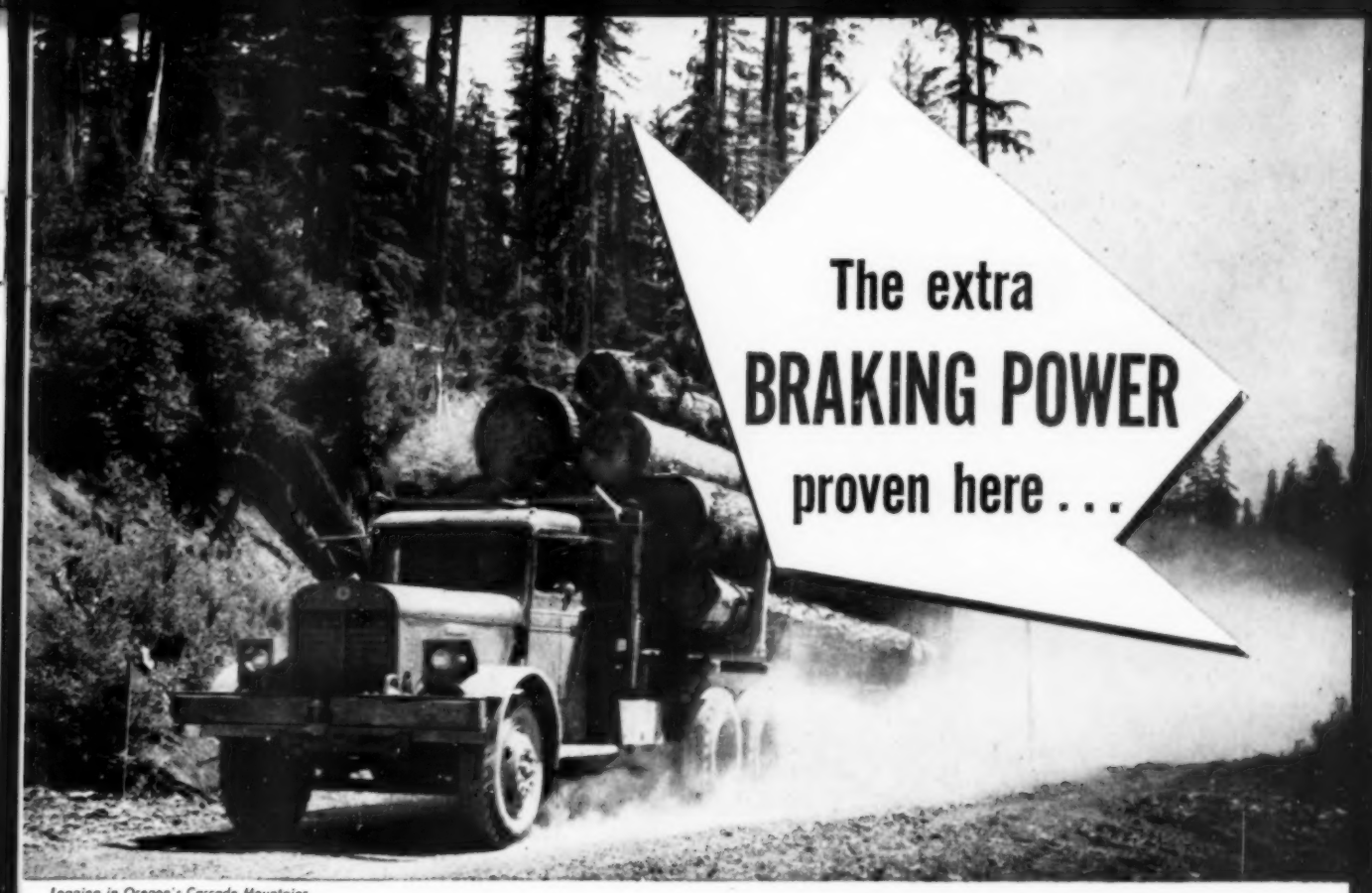

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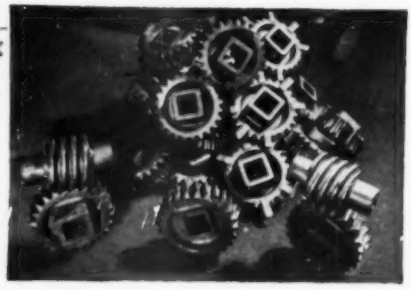

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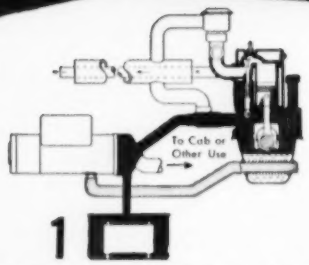
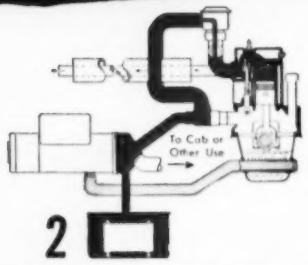
South Wind Heaters include units of 20,000, 30,000, 50,000, 60,000, 100,000, 200,000, 600,000, and 700,000 BTU/hr. capacities. There is a model to meet every internal or external pre-heating requirement. South Wind field engineers are ready to consult with you on any specific problems you may have. Write today to South Wind Division, Stewart-Warner Corporation, Indianapolis 7, Indiana.

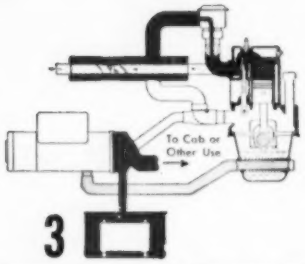
South Wind 3-phase internal pre-heating



Pre-Heat Phase—Clean, *dry*, hot air is used to pre-heat critical engine moving parts *directly* and to remove damaging moisture *from engine interior—before engine cranking is attempted.* (Note: Heat duct to cab for defrosting and cab heating is closed until after engine is started.)



Starting Phase—Heat into engine crankcase is diverted (as shown) to air induction system to elevate temperature of fuel-air mixture and promote rapid, normal combustion in chambers. Internal pre-heating of critical parts and normal lubrication frees bearings, shafts, pins and pistons from starting strain and friction wear.



Operational Phase—After easy starting, normal engine operating conditions are sustained. Now, South Wind's clean heat can be used to heat the cab, defrost windshield and supply engine induction air heat. (Note: illustration shows how normal engine induction air temperature can be sustained by engine exhaust heat exchanger.)

Model 1060
60,000 BTU/hr.
fresh air output
Total output,
90,000 BTU/hr.

Model 1030
30,000 BTU/hr
fresh air output
Total output, 50,000 BTU/hr.

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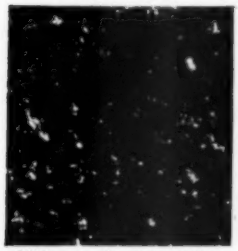
WINDSHIELD DEFROSTING

Heavy Zinc Phosphate Coatings for Steel

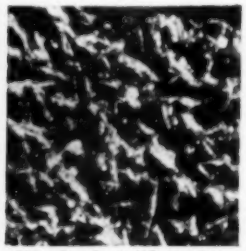
In developing the Oakite CrysCoat HC* Process—which converts a steel surface into a continuous coating of complex metal phosphates—the chemists of the Oakite Research Laboratory made use of a chemical reaction which conquered some of the major obstacles that interfered with the success of older phosphating processes.

The primary aims of this research were to produce a phosphate coating that would provide a good foundation for paint and would give the steel reliable protection against electrochemical corrosion.

These aims were realized with a coating—composed principally of zinc phosphates—that weighs more than 200 milligrams per square foot, thus exceeding the requirements of U.S. Government Specifications JAN-C-490, Grade 1; 57-0-2C, Type 2, Class C and PA-PD-191, Rev. A. In regard to corrosion, the test panels usually run well over 500 hours in the salt spray chamber without showing any signs of blistering or peeling in the types of paint ordinarily used in ordnance production.



Without a phosphate coating, cold-rolled steel possesses poor paint-bonding characteristics and no protection against electrochemical corrosion.



This CrysCoat HC coating of phosphate crystals protects against corrosion and provides an excellent foundation for paint. Magnified 67.5 times.

Secondary aims of the research were to develop a process that would produce little sludge and scale, that would not require overly expensive equipment and that would be easy to control.

While all of these aims were accomplished, the most remarkable gains were made in the field of control.

Perhaps the best way to describe the simplicity of the Oakite CrysCoat HC Process is to say that it requires no skilled chemist to serve as baby-sitter.

Only one material—the liquid called Oakite CrysCoat HC—is used in the phosphating stage. No other material—such as accelerator, starter, toner or other additive—is used for making up the solution or for keeping up its concentration.

Only one type of titration is needed to keep the CrysCoat HC process under control and there is no need for regular determination and adjustment of pH.

More information about the simplicity and reliability of the Oakite CrysCoat HC Process is given in a 12-page, illustrated booklet titled *"How to apply better zinc phosphate coatings to steel in preparation for painting."* To obtain a free copy, mail the coupon at the right.

At Consolidated Industries, Lafayette, Ind., Superintendent Edwin Everhart and Oakite Technical Service Representative Walter Sittman watch part of a disposable gas tank go into the CrysCoat HC solution.

*HC means Heavy Coating

Advertisement

*This comment came from a Pennsylvania munitions maker, who added that Oakite CrysCoat HC has put an excellent zinc phosphate coating on 385,000 shells with "absolutely no trouble . . . maintenance and control are very easy."

The Oakite CrysCoat HC coating on steel products—such as artillery shells, rocket fins, auto parts, etc.—weighs more than 200 milligrams per square foot. It more than meets the requirements of U. S. Government Specifications:

JAN-C-490, Grade 1 **57-O-2C, Type 2, Class C**

PA-PD-191, Rev. A

The Oakite CrysCoat HC Process for preparing steel for painting—either in spray-washing machines or in tanks—has five big advantages:

1. The heavy CrysCoat HC coating forms a strong foundation for the lasting adhesion of paint. *See page 5 in free booklet.*
2. The heavy coating gives excellent protection against electrochemical corrosion. *See page 7.*
3. The CrysCoat HC Process is easy to control. Only one material is used for make-up and up-keep. No accelerators, starters, toners or other additives are needed. Only one simple type of titration is used. *See page 9.*
4. The CrysCoat HC reaction produces relatively little sludge and scale. *See page 10.*
5. Stainless steel is not necessary for all parts of the equipment. *See page 11.*

FREE For complete information, mail the coupon for a copy of our 12-page illustrated booklet describing the Oakite CrysCoat HC Process.

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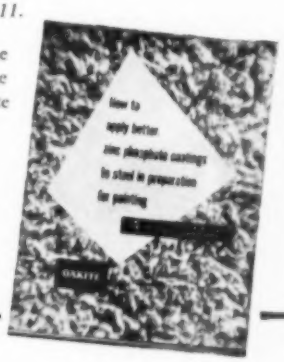

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*Company*_____

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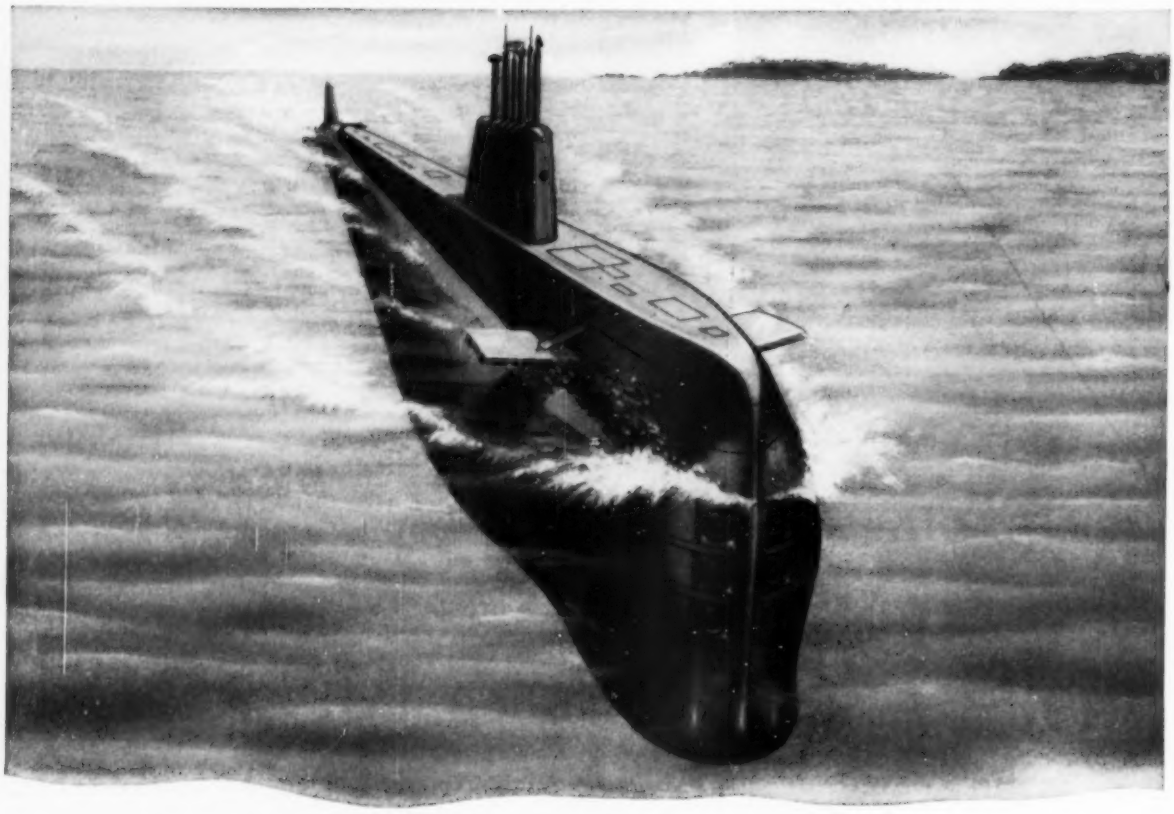

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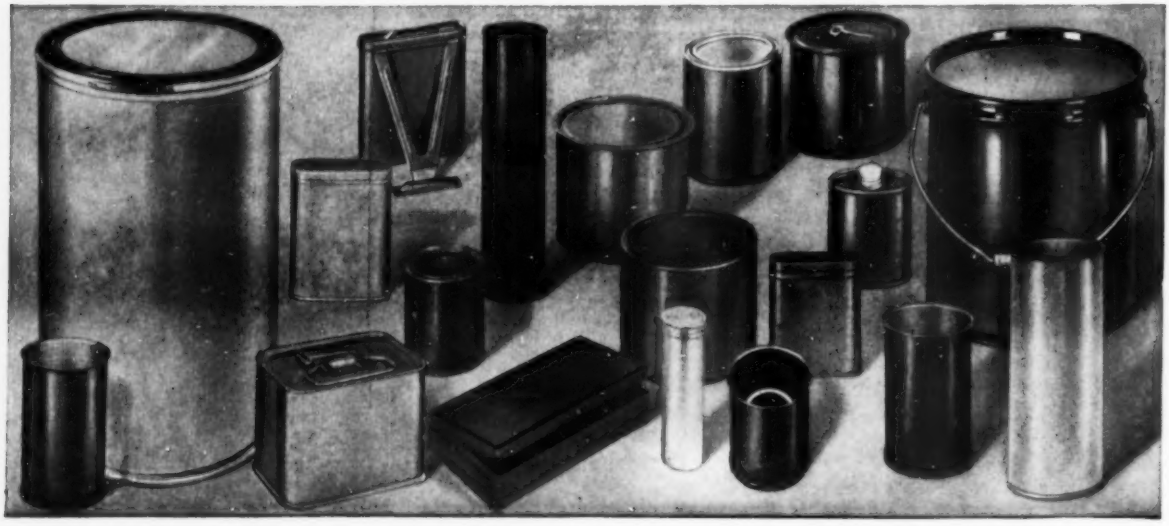

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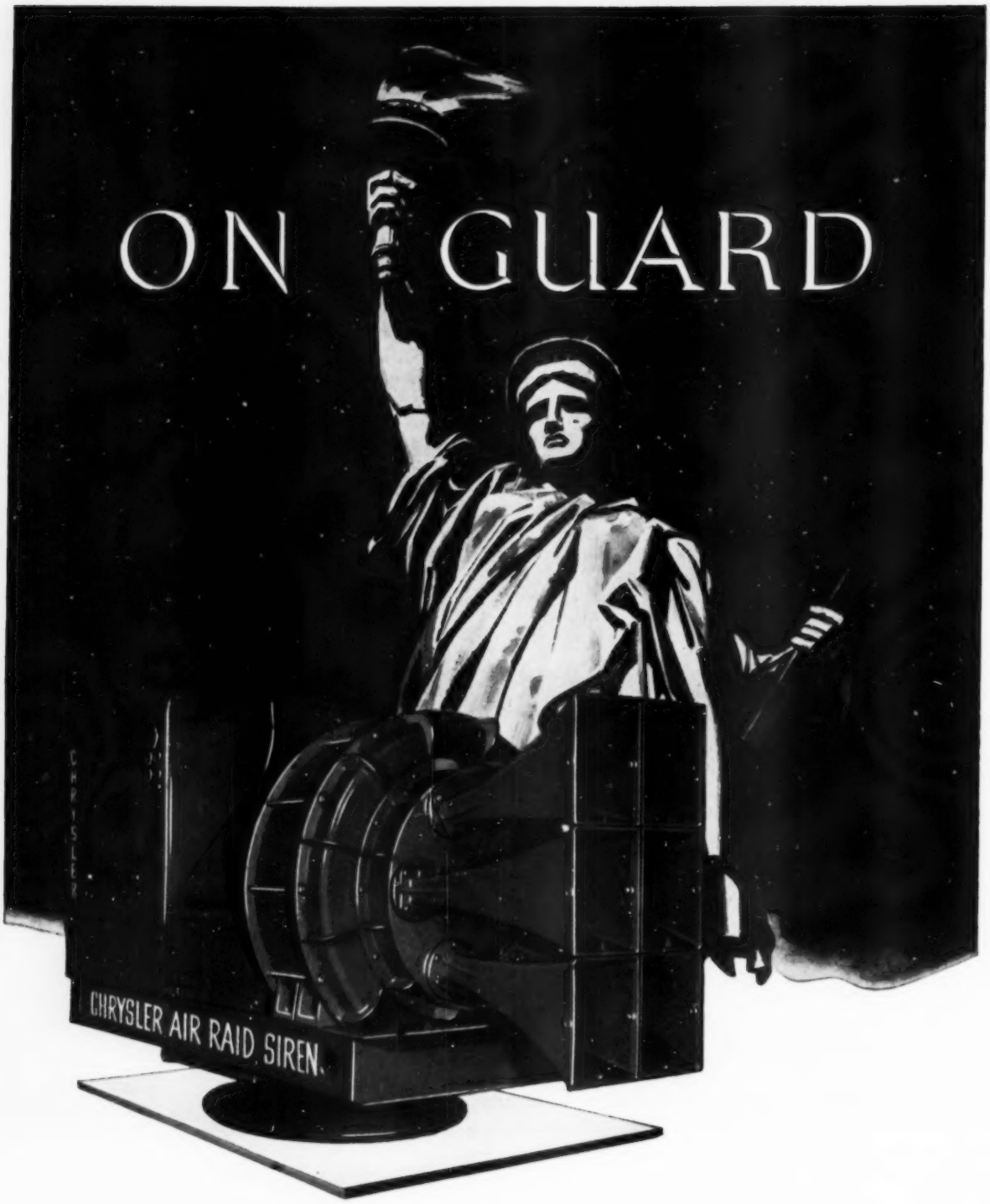

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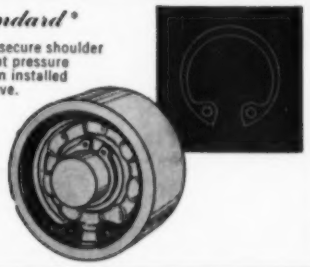
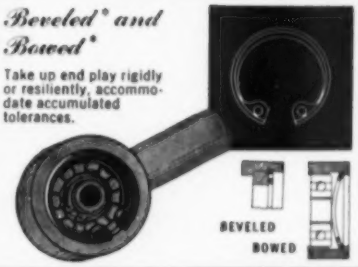
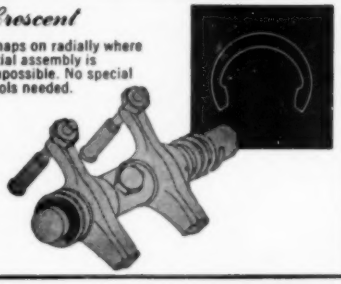
Standard* — Forms secure shoulder for tight pressure fit when installed in groove.



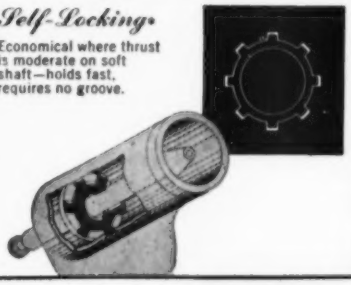
Beveled* and Bowed* — Take up end play rigidly or resiliently, accommodate accumulated tolerances.



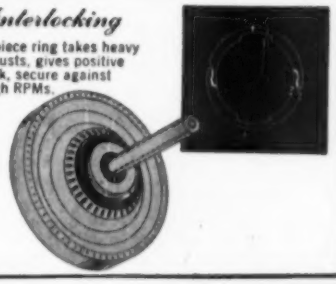
Crescent — Snaps on radially where axial assembly is impossible. No special tools needed.



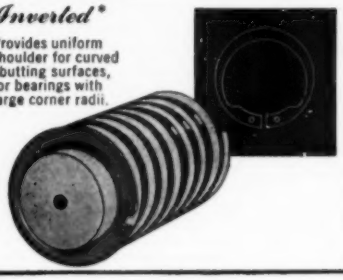
Self-Locking* — Economical where thrust is moderate on soft shaft—holds fast, requires no groove.



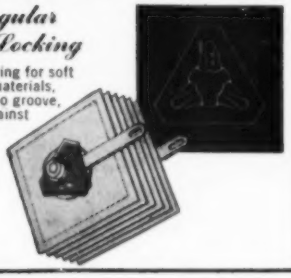
Interlocking — 2-piece ring takes heavy thrusts, gives positive lock, secure against high RPMs.



Inverted* — Provides uniform shoulder for curved abutting surfaces, for bearings with large corner radii.



Triangular Self-Locking — Low cost ring for soft shafting materials, requires no groove, secure against vibration.



E-Ring — Provides large strong shoulder for small shaft. Applied radially.

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ATOMIC ENERGY

PAST AND FUTURE TRENDS

GORDON DEAN

Past Chairman, Atomic Energy Commission

It is difficult at the end of a period of intense and frequently hectic activity to sit back and try to separate those atomic developments which are most likely to have the most significance in the perspective of time. If I had to compile such a list from the events of the past few years, however, I think I would include the following:

Developments Listed

First, the enormous expansion programs that have greatly stepped up the rate at which weapons materials are being produced and that will increase it even more substantially in the future.

Secondly, I would list the development of a family of atomic weapons—a family which includes new designs of almost any usable energy release, small or large, and of almost any size. As part of this, I would also include the scientific progress of the Los Alamos Laboratory which has resulted in the much more efficient use of fissionable materials in weapons.

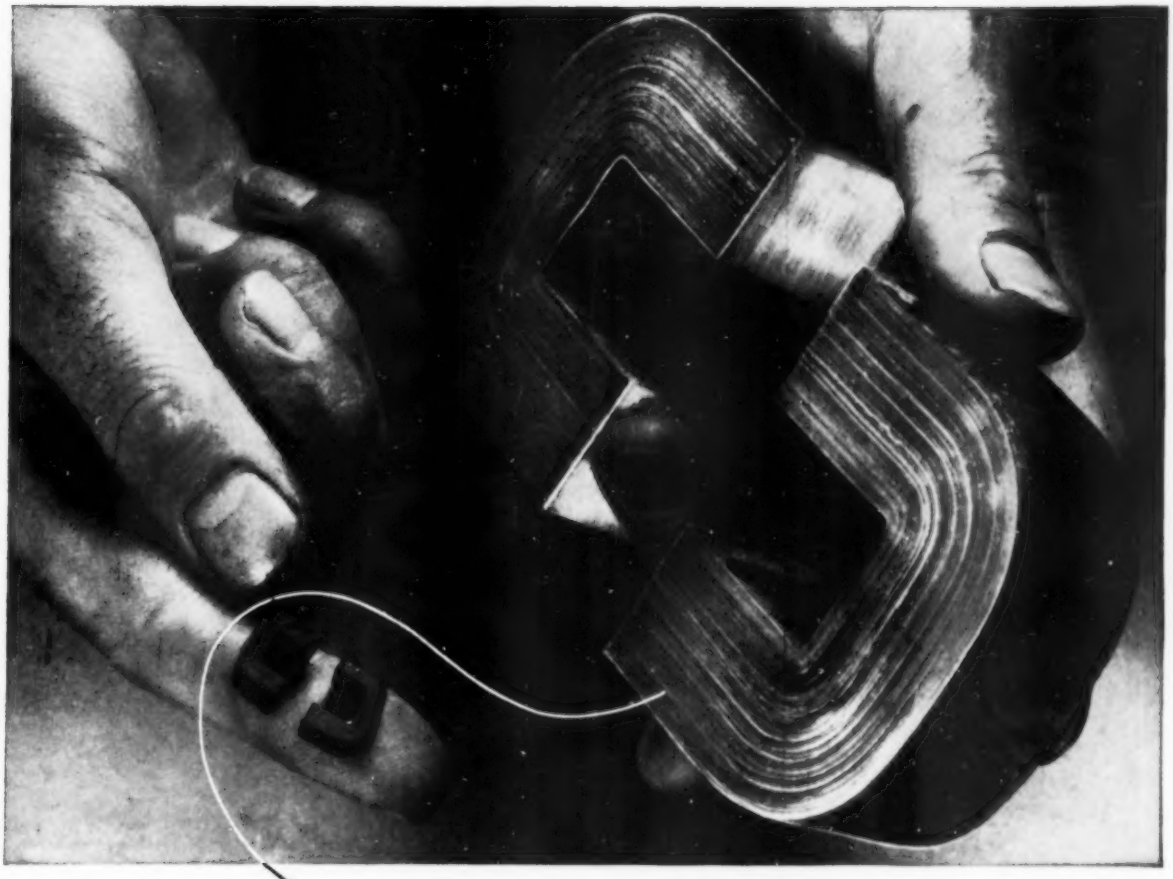
This, in turn, has had the effect of greatly increasing the military effectiveness and explosive potential of our national stockpile of weapons without the expenditure of additional fissionable material.

Thirdly, I would list the advancement in reactor technology which has resulted in the production of experimental quantities of usable power, the development of an atomic submarine engine, the demonstration of the feasibility of breeding, and stimulation of hopes that commercially competitive atomic power can be achieved within the next few years.

Uranium Plentiful

Fourthly, I would list the fact that the available supply of uranium is no longer the limiting factor that it has been considered to be in the past. Whereas we used to think that uranium is where you find it, we are now beginning to realize that it is very often where you look for it—at least the low-grade deposits. The more we have looked for it, and the more we have encouraged others to look for it, the more we have found.

New deposits have been discovered in this country, in Canada, in Australia, and elsewhere, and processes have been developed which have made it possible for us to tap the very large low-grade reserves of South Africa and of the phosphate regions of the United States. There is no



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question but that enough uranium can be found and extracted from the earth to support a large-scale atomic-energy industry for generations.

One of the things that has impressed me in reflecting upon the last few years in atomic energy has been the number and significance of the developments which have taken place outside of the Commission's own program. Of these, perhaps the one with the most far-reaching significance is the interest in atomic energy which has developed all over the world, in one nation after another.

We never had a monopoly in this country in atomic energy. All we had was the exclusive possession of a stockpile of atomic weapons for a few years. Even that now has gone. Two other countries, the Soviet Union and Great Britain, now have atomic bombs. In addition, atomic-energy programs for peaceful purposes have sprung up in Canada, Britain, France, Norway, Holland, Sweden, Belgium, and Italy, among others.

Four countries of the free world besides the United States now possess nuclear reactors: Canada, Britain, France, and Norway. If you have a large reactor, you can produce fissionable materials, and if you have fissionable materials, it is no trick to make bombs. Sweden has one under construction, and several other countries, including Belgium, are drawing up reactor construction plans. The Norwegians share their reactor with the Dutch. . . .

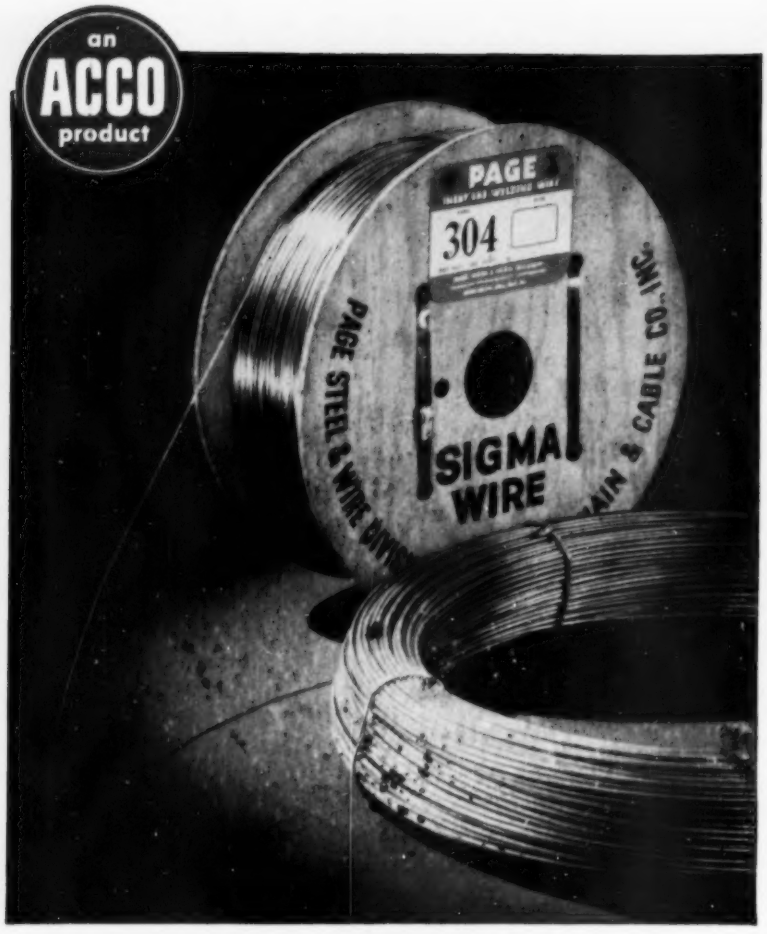
Future Progress

As to the future, there are several things that I believe are vital to continued atomic progress in this country. First, I believe it is enormously important that our present huge expansion programs be rushed through to completion as rapidly as possible. We need the fissionable material and weapons these new plants will produce as soon as we can get them, and I hope fervently that there will be no cutback in the construction programs now under way.

From where I sit today, however, I can see no need for any further major expansions of the type we have undertaken in recent years.

Secondly, I believe it is of the utmost importance that this country maintain the strongest program of basic research that it can mobilize in the field of atomic energy. Our production and developmental programs feed on the results of past research, and if we want progress in the future we must lay the groundwork for it now. . . .

Thirdly, I believe this country should continue to carry on an extensive and imaginative weapons-test program so that we can continue to add to the variety of weapons at our disposal and increase the



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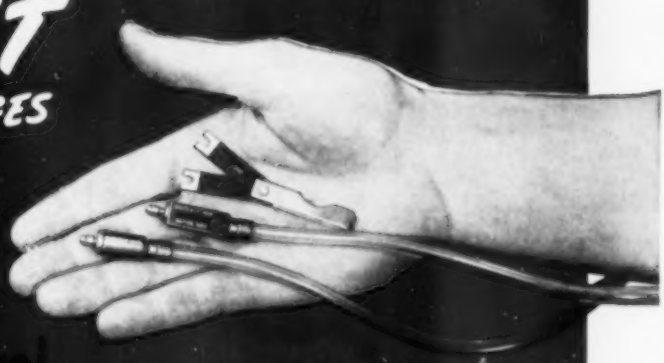

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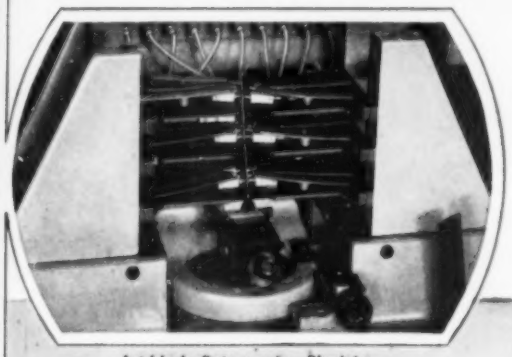

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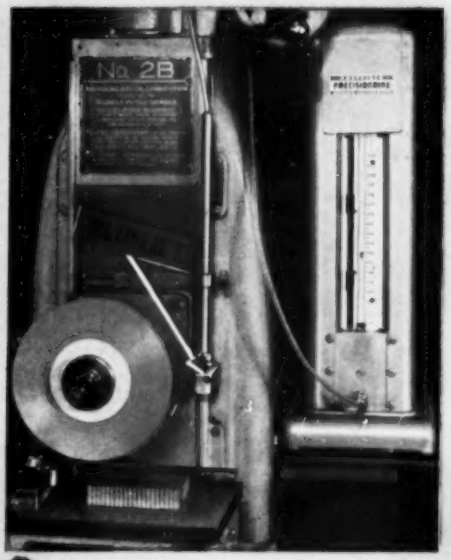

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efficiency with which we utilize fissionable materials. Each advance in this field gives us the same result, and with the expenditure of less material, as the construction of another new gaseous-diffusion or plutonium plant. I hope there will be no cutback in our weapons development and test programs. I think we must, if we are to continue to progress—almost literally—try everything.

Changes Needed

Fourthly, I think we must have changes in our atomic-energy law which will give the Commission the flexibility it needs to deal with other countries, particularly our allies and our friends who are supplying us with the raw materials we need for our weapons program.

I think we should, and must, help these programs outside our borders because in the long run we will ultimately be helping ourselves. . .

Fifthly, I believe we must have a change in the atomic-energy law, as we have recommended, to encourage and permit industry to contribute its rightful share in the future development of atomic power and the many other peaceful applications of this new science.

I also believe it is vital that the Government think seriously about issuing much more information about atomic energy. The Commission exists and operates behind a wall of secrecy, and about all the public ever sees of it are the spectacular end products which mark the achievement of one of its goals, such as the shots in Nevada.

There have been good security reasons why this wall has been maintained. But now there are developing many good reasons why it should be opened up a crack or two. For one thing, the Congress is presently looking into the desirability of changing the atomic-energy law. The objective of this change, if it takes place, will be to permit wider participation by groups other than the Commission in the power-development program.

Greater Knowledge

It is important, I think, that while this change is being debated every Congressman and every citizen should know more about atomic power—what it is, and what it means—than he does today.

And if the law is changed and if industry is granted wider participation in the power program, it seems to me that industry must know all it can about the full potential of the atomic power business. There must be more discussion, more education, and more training, and a necessary part of the achievement of these things is to make more information available.—*From Mr. Dean's remarks at a press conference preceding his retirement as Chairman of the A.E.C.*

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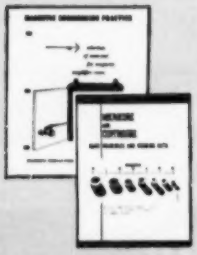

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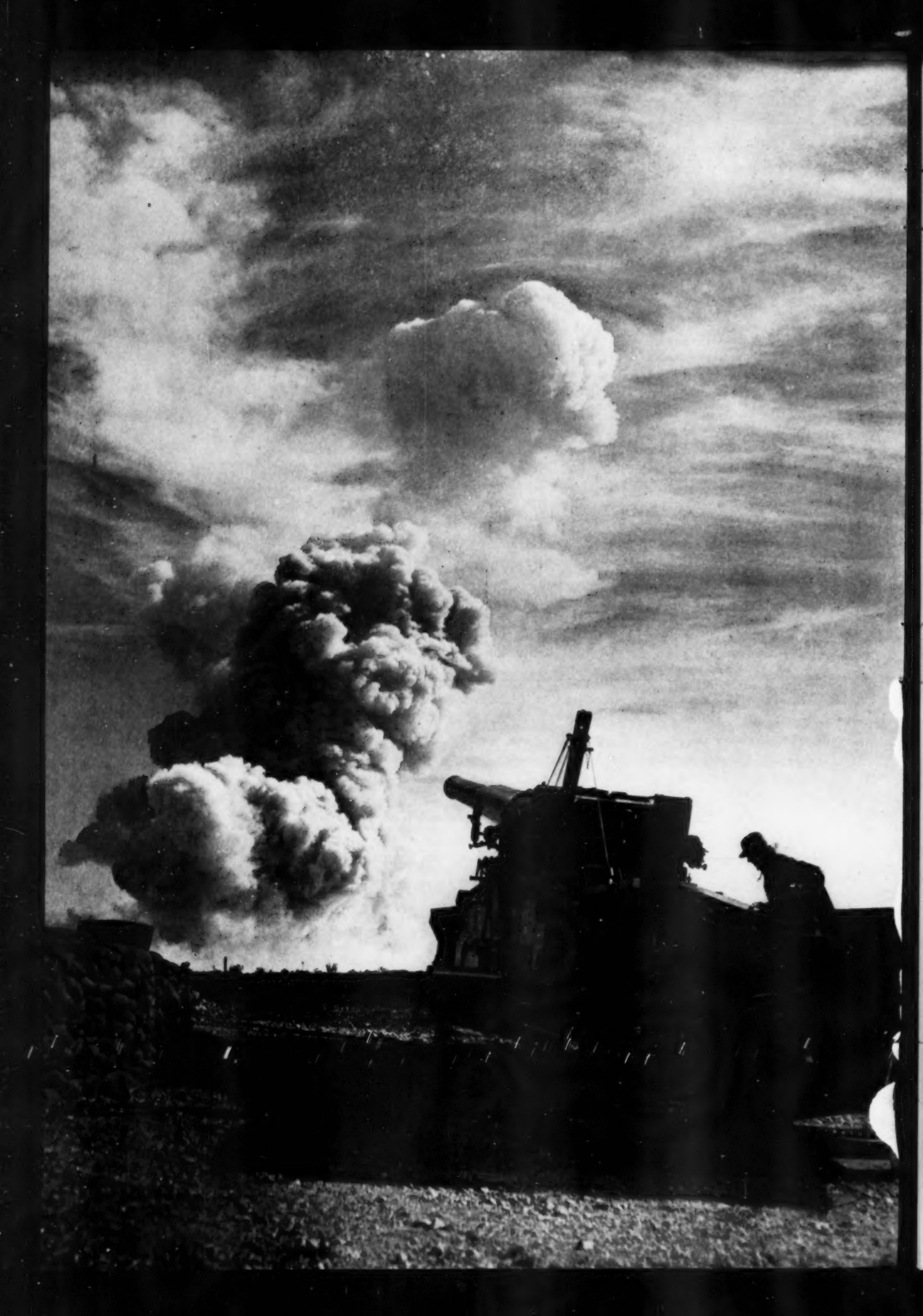


The Atomic Horizon Broadens

Wide Peaceful Applications To Follow Defense Era

THOMAS E. MURRAY, a member of the U. S. Atomic Energy Commission, recently deplored the lethargy about the colossal arms race in which our Nation is engaged and called for immediate action to acquaint the average citizen with the facts of atomic life and their awesome significance for the near future of our tense and savage world.

Secrecy Attacked

In a somber speech delivered at Manhattan College in New York, Mr. Murray attacked what he regarded as excessive, ignorance-breeding secrecy in all matters pertaining to atomic power.

"We now find American democracy fashioning domestic and foreign policy with faulty vision, blind or unaware of the great bearing that the atomic arms race ought to have on wise policy making," he asserted.

"It seems clear to me, as one of the so-called experts," he added, "that the effect of this abandonment of the normal functioning of public opinion—this refusal to face the facts of atomic life—can be disastrous."

Mr. Murray deplored the idea that the life and death of humanity at large should become dependent on the actions of a very small group of people who know that the hydrogen bomb can be at least as deadly as twenty million tons of high explosives.

Is the twentieth century "closing time" for the human race? No categorical answer to this ominous question is possible. There are two alternatives: Mankind now has within the range of its grasp the means of its own total destruction. The second alternative is that atomic power can be harnessed to create a bright new era throughout the world.

There are many thoughtful people today who agree with Mr. Murray that the time has come to adopt a more realistic attitude regarding atomic energy.

This new realism would apply in three interlocking areas—information, use, and ownership.

Undoubtedly many of the facts relating to atomic energy should not be disclosed to the public for military-security reasons. Yet there is a considerable amount of information, now deeply buried in bureaucratic red tape, to which the public is entitled and which should be released to the general public without further delay or procrastination.

Mr. Murray has made four practical suggestions: We should maintain our armed strength in the post-Korean period; we should exercise prudence to avoid another global war; we should be permitted to know more about the latest discoveries of science which have become, for all of us, a matter of life or death; and we should pray!

Who should own atomic energy? Charles E. Wilson of General Electric has expressed the common-sense view that atomic power should be developed by private industry and that stock ownership should be held by men and women in all spheres of human activity.

Eminently Qualified

The new chairman of the Atomic Energy Commission is eminently qualified to assist in this transition and in broadening the base of atomic progress.

Lewis L. Strauss has had a distinguished naval career. He worked in closest coöperation with one of America's most sagacious and distinguished statesmen—the late James Forrestal. He has an outstanding record in industry and finance. His membership on the Council of the American Ordnance Association is further convincing proof of his unselfish patriotism, his superb qualities of leadership, and his unswerving devotion to the best interests of our Nation—in war and peace.

Lewis L. Strauss, the new Chairman of the Atomic Energy Commission, whose photograph appears on the front cover of this issue, was born in Charleston, W. Va., on January 31, 1896.

His initial experience in Government (1917-1919) was as secretary to Herbert Hoover in relief operations in Belgium and elsewhere overseas, and in the U. S. Food Administration.

He has been in the Naval Reserve for twenty-seven years and was on active duty from 1941 to 1946. He was successively promoted through the officer grades to the rank of rear admiral.

Admiral Strauss' Navy assignments included: staff assistant to the Chief of the Bureau of Ordnance; Assistant Chief of Procurement and Material; Special Assistant to the Vice Chief of Naval Operations; Special Assistant to the Secretary of the Navy; and the Navy member of the Interdepartmental Committee on Atomic Energy.

From 1946 to 1952 Admiral Strauss served as a member of the Naval Research Advisory Committee.

In 1946 Admiral Strauss was appointed as a member of the first Atomic Energy Commission and served until 1950. After his resignation as Commissioner, he was appointed by the Joint Congressional Committee on Atomic Energy as its consultant.

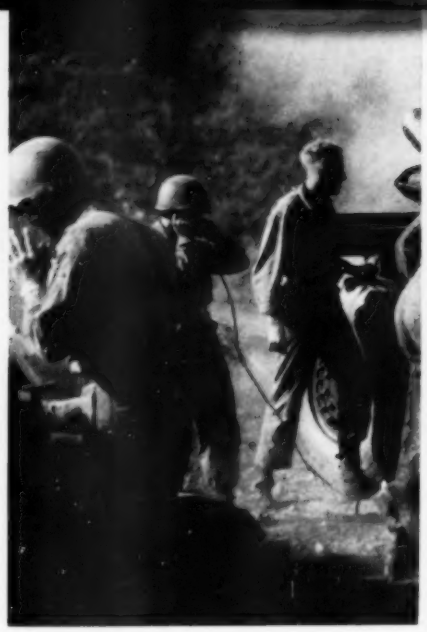
Since 1950 Admiral Strauss has been consultant and financial adviser to the Messrs. Rockefeller. He has also been a director of many business enterprises.

HEARD ROUND THE WORLD *was the first atomic artillery shell in history, fired recently from the Army's new 280-mm. gun at the atomic proving ground, Frenchman's Flat, Nev. (Army photo).*

Arms and the War

The Type of Conflict Should Govern Our Selection of Weapons for Combat

Maj. Gen. J. F. C. Fuller



THE recent relaxations, both internal and external, in the policy Russia has maintained since 1945 have obviously been made in order to improve her political, economic, and strategic situation—otherwise they would have no sense. Therefore they should be received with caution and for the time being accepted as a maneuver rather than a retreat.

Although their framework is still obscure, certain elements are apparent. Politically, the death of Stalin removed the helmsman, and a period of quiescence is necessary until an adequate replacement is proved out. Economically, from all accounts, the conditions in most of the satellite countries are desperate, and those in the U.S.S.R. none too good; therefore a halt in collectivization and subjugation is called for in order to mitigate opposition.

Korea a Blunder

Strategically, the war in Korea has proved itself to be a blunder; for instead of discrediting the Western Powers, it has precipitated their rearmament. Therefore a tactical change in policy is called for to disrupt it. If, on the part of Russia, these powers are put to sleep again, a new start in World Revolution can be made.

As regards the first two points, I do not intend to say more, because the subject of this article is concerned solely with the third; and now that we are presented with a pause in world relations, the first question we should ask ourselves is, for what type of war should we arm? Obviously, if we choose the wrong type we shall be dished. What, then, are the types we have to choose between?

There are two. The aim of the one is to win a war in the first battle or campaign with existing forces; the aim of the other is to win the last battle or campaign with reserve forces.

Two Champions

The one is based on the idea of victory in the shortest possible time and at the minimum operational cost and damage. The other predicates a prolonged conflict carried out at enormous cost and progressively leading to world chaos.

Strangely enough, these two types of war have recently found their vocal champions in the two men who, above all others, should have seen eye to eye—General Ridgway and Field Marshal Montgomery.

The one, in his swan-song as Supreme Allied Commander in Europe, has precisely stated that, unless the NATO forces in Germany are powerful enough to defeat an initial Russian attack, the Western Powers "will remain exposed to the peril of decisive defeat."

In other words, unless they are capable of winning their first battle, it is likely to prove their last, for "decisive" means final and conclusive.

The other, on March 30th, at the National Press Club in Washington, said: "A small shield in front, big reserves behind, which are organized—properly organized—and the war is won; mind you, not by the active forces you keep up in peacetime, which are small. The war is won by the nation in arms behind the shield which mobilizes and gets cracking quickly. . . Remember that the first shock is taken up by the shield, and it is the organized reserves which come along and really do the business."

Who is right? Before I touch upon existing conditions which bear upon this question, it is as well to refresh our minds with a little recent war history.

In World War I, the German plan was to win the war in a single campaign of six weeks' duration. Because it failed to do so, does this support the Montgomery theory? Not at all, for at the time the means were adequate. It failed because they were faultily distributed.

The Schlieffen Plan

Field Marshal von Schlieffen, it will be remembered, urged that the German right wing should be as strong as possible. Field Marshal von Moltke, although in 1914 he had more troops at his disposal than Schlieffen had in 1905, thought otherwise and reduced the strength of the right wing by several corps, which he added to the left wing.

Had he but left the Schlieffen plan as it was, there is not the slightest

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General Fuller, noted British soldier-author, is one of the outstanding military analysts and historians of the present day. He is a frequent contributor to ORDNANCE.

Army photo

doubt that within six weeks Paris would have been occupied, and a fortnight later seven-eighths of the French armies and the British Expeditionary Force would have been driven pellmell into the Rhine.

I will next turn to three of the initial attacks of World War II.

At the very start Poland was overrun in 17 days, and her resistance obliterated by 6 armored and 6 motorized divisions supported by some 2,000 aircraft.

The advance on Warsaw was so rapid—240 kilometers in 8 days—that completion of mobilization on the part of the Poles was impossible. Instead of their forces getting cracking, they were cracked up at their points of assembly, and at a cost to the Germans of no more than 10,572 killed, 30,322 wounded, and 3,400 missing.

The lesson of this campaign is clear enough—it is that, in face of superior mechanized forces, ready to take the field when the flag falls and boldly led, mobilization within striking distance of them is impossible.

Wavell's Attack

Next, I will turn to General Wavell's initial attack in Libya. He was faced by some 180,000 Italians fully mobilized, and although he had no more than 31,000 troops, 120 guns, 275 tanks, and a small air force, he did not wait for reserves, as Montgomery would undoubtedly have done.

Instead, he seized the initiative, surprised his enemy and in 62 days took 130,000 prisoners, 400 tanks, and 1,200 guns at a cost to himself of 500 killed, 1,373 wounded, and 55 missing. In all, he advanced 500 miles.

The lesson here is that, when in mechanized warfare the initiative is coupled with surprise and bold generalship, numbers are of secondary account.

Lastly, I will take the conquest of France. In 1940 the French plan was closely related to the Montgomery theory of a forward shield—the Maginot Line and antitank obstacles—supported by a reserve sword. Not that the French and their allies were numerically inferior to the Germans or inferior in tanks; they were not.

What they were inferior in was in the spirit of the initiative. What they failed to realize was that armored warfare is very similar to old-fashioned cavalry warfare. Its vital element is movement. Static operations are as abhorrent to tanks and aircraft as they once were to heavy and light cavalry.

If these mobile arms cannot move forward, they will have to move backward, and the higher their mobility the greater will be the consternation they will produce among the mobilizing reserves in rear of them.

The lesson to be learned from this is that today it is no longer the slow process of a nation getting into its harness—the nation in arms—which commands victory. Instead, it is the fully harnessed army in the field, which, like a fire brigade, is in instant readiness.

Scope Limited

That Germany was ultimately defeated was due, not to the fire-brigade idea being wrong but because it was limited to land warfare. It was not the mobilizing reserves in Great Britain which defeated Hitler, or could have defeated him; it was the English Channel.

Could Hitler have crossed it, as William the Conqueror did, a total German victory in the West would almost certainly have followed. He was in no way prepared to do so. Political genius though he undoubtedly was, as a general his intuitions were so limited that he overlooked the geographical fact that England is an island.

"In scientific warfare, he who prepares for the defensive digs his own grave"

In themselves, these three examples—and others could be added—are sufficient to blow the bottom out of the Montgomery theory. It is antiquated and pre-Napoleonic. It dates back to the days when, on account of cost, standing armies were small and only began to mobilize when war was declared; when movements were limited to the muscle power of man and beast; and when armies went into winter quarters and methodically prepared for the following spring campaign.

It savors of early eighteenth century warfare and, worse still, appeals to the ill-informed, war-weary peoples of the twentieth as a short cut toward security with economy.

It leaves out of account the whole gamut of present-day conditions, which

bear no resemblance to those which faced Turenne, Villars, Eugene, Marlborough, and Saxe. Then wars were the sport of kings—tourneys de luxe—which were punctiliously heralded and at times ceremoniously waged.

Now they are annihilative struggles between nations, frequently launched without a warning or with a declaration of war coinciding with invasion in order to surprise and destroy such forces as the enemy may have in the field before his reserves can mobilize.

This immediacy of attack is becoming, not only more and more feasible, but strategically more and more essential, since aircraft now dominate military operations and the atomic bomb provides them with a weapon capable of obliterating troop concentrations, disembarkations, and rail and road centers before a single reservist can put his boots on.

Further, whereas in the past, fortifications, river lines, and mountain ranges were major obstacles to an advancing army, today their delaying power is normally negligible. In fact, the airplane and the atomic bomb have strategically so leveled all but the most remote theaters of war that it is now easier to maneuver over a country such as Switzerland than over the Sahara.

Even in the last war, the mountainous regions of Yugoslavia and Greece offered few difficulties to the German mechanized forces; Crete, an island, was taken from the air in a stride; Norway was occupied in a question of hours; and great rivers, like the Danube, Rhine, Don, Dnieper, and Dniester, which in former ages frequently were obstructions, were no obstacles at all to airborne troops.

One Parade Ground

In short, military science is now rapidly rolling the entire world and its oceans into one vast, strategical parade ground.

In an age of supersonic speed and guided missiles, as space shrinks so does range of striking power increase so that military time—that is, time to operate in—is steadily being whittled down from months to days, days to hours, and hours to minutes.

Time has now become more important than force, and mobility incomparable more puissant than numbers. Comparatively speaking, the slow-moving fighting forces of 1939-1940 are today almost as obsolete as the static, ground-groveling armies of 1915-1916.

And because it was possible, as we know, for the former to overrun whole countries in from two to six weeks, now it is becoming increasingly possible to obliterate all their vital centers—military, air force, naval, and industrial—in as many hours.

Even if we omit one and all of the military inventions and developments since 1939, it is a profound fallacy to suppose that the defensive—"the shield," as Montgomery calls it—carried out by small and presumably mobile groups, will in any of the many possible theaters of war be more effective in halting a Russian advance than did the Maginot Line the German in 1940.

Not Economical

Also, it is an equal fallacy to imagine that a defensive war is economical in manpower. As General Ridgway pointed out, the NATO front is now 4,000 miles in length, and even if we omit all fronts except the one between Lübeck and Trieste, which, as the crow flies, is 600 miles long, how many "small forces" will be required to take the first shock of a Russian army of, say, 40 armored and 40 infantry divisions and 10,000 aircraft?

Further still, as the initiative will be with the attacker, who is free to select whatever thrust point he likes, will the shield, when the flag falls, be at the starting point? Will it even be on the racecourse of battle at all?

The truth is that there is no more likelihood of containing a Russian advance on the lines advocated by Field Marshal Montgomery than there is of holding water in a sieve.

Although it is common sense to base the solution of the problem on the axiom that the military effort of a nation must be balanced against its economic capabilities, it is not necessary to jump to the conclusion, as Montgomery does, that because "a nation or a group of nations cannot afford to maintain in peacetime . . . the total forces needed to resist aggression," resisting aggression should be the aim.

Where, from the start, he hamstrings his solution is by basing it on two related postulates: that the problem is a defensive one and that Russia holds the initiative.

Placed as she is on interior lines—so the argument runs—Russia can strike westward into Europe, southward against the Middle East and eastward in the Far East. Therefore, because it is not possible to be certain where the blow will fall, the defensive must precede any thought of an offensive.

It needs but a moment's consideration to discover that in this argument the operative word is "initiative," and because Russia at present possesses it, the solution should be sought, not in accepting this as inevitable but rather in how she can be deprived of it at the outset of hostilities, even should the chances of wresting it from her be odds against success. This, as I will show, is far from being the case.

Now, the key to this mystery, which so far has bemused the West, is to be sought in the fact that every strategical problem has what Clausewitz calls its "center of gravity." When considering war against a coalition of powers he said:

"We may establish it as a principle that if we can conquer all our enemies by conquering one of them, the defeat of that one must be the aim of the war, because in that one we hit the common center of gravity of the whole war."

In other words, in strategy the center of gravity is what the decisive point is in tactics.

By substituting tactical areas for allied armies, with equal logic we can say: If we can conquer all areas by defeating the enemy in one area, the defeat of him in that area must be the aim of the war, because in that one we hit the common center of gravity of the whole war.

Where, today, is the strategical center of gravity to be discovered? Certainly not in the Middle or Far East,

important though they may be. It is to be found between the Vistula and the Rhine, and its heart is Eastern and Western Germany. Should the Russians be able to occupy Western Germany and consolidate themselves there, what remains of Western Europe is at their mercy, whether by military or psychological attack.

Conversely, should the Western Powers at the outset be able to win a decisive battle in Eastern Germany, the high probability is that the moral shock to Soviet prestige will be so great that all the occupied countries will explode into revolt and that the chaos resulting will completely unhinge Russian logistics; that is, for the time being, Russian troop and supply movements will be paralyzed.

This is by no means a wishful dream, for the workers' risings last June against the dictatorship of the proletariat in East Berlin and other East German cities showed beyond doubt that the Soviet dominion in the occupied countries is poised on a knife edge.

Nor is it mere wishful thinking to assume that a revolt, even unarmed, in the occupied countries would not in its turn detonate revolt among the subjugated peoples within the U.S.S.R., which, if supported, might lead either to the collapse of the Soviet régime or its withdrawal from Europe.

Is such a decisive victory possible? Otherwise put, are the forces required to win it within the economic capabilities of the nations concerned?

At present, the answer is—No! Because the pivotal nation—that is, the nation occupying the western half of the strategic center of gravity—is omitted from Western calculations. All along the problem has been how to fill in the strategical vacuum created in the center of Europe by the results of the last war. Instead of tackling it strategically, it has been muddled politically, largely in order to appease France, whose political system is so unstable that it is impossible to rely on her from one day to the other.

Not Meant To Work

Hence the European Defense Community, a French conception, which was never meant to work and with the best of will on the part of the West German Federal Republic is never likely to.

The time is long overdue to be quit of this humbug and to take the bull by the horns; that is, fill in the vacuum. Even were this to mean agreeing to the Federal Republic raising whatever army it liked—and, in my opinion, the more powerful the better—the only possible danger to France is that it might throw in its lot with the Russians, a contingency so remote as to be absurd.

It is just as absurd as it is to suppose that, in this age of group wars, Germany single-handedly could ever again challenge the peace of Europe.

"Ready-made and well-tamped explosives surround the Russian communications, which only demand a little skill and tons of courage on the part of the Western attackers to detonate into a full-scale guerrilla war at the outset of operations."

Granted a rearmed Western Germany as a member of NATO (why not Spain also?) it becomes possible to combine shield and sword, instead of relying on a gladiator armed with the sword attempting to cover his twin brother, 300 to 3,000 miles in rear of him while he is collecting the shield from the mobilization cloakroom.

This combination will give us the type of force required to fight a decisive battle, if besides defensive power (typified by the shield) and offensive power (typified by the sword) the whole is endowed with the highest attainable mobility.

This is essential. First, because velocity is the answer to numerical superiority. Secondly, because in atomic warfare ability to move dispersed and to concentrate rapidly and then disperse again is the only practicable protection.

Thirdly, since because of its size an attacking or defending Russian army will be compelled to advance or deploy on a wide front in order to guarantee its supply, and since its lines of communication will run through potentially hostile countries, the tactical aim should be to defeat numerical superiority by penetrating this extended front at one or more selected points, awaken revolt in rear of it, and paralyze the enemy communications.

Psychological Volcano

In this instance the novelty which differentiates so audacious and all-out an attack from a gamble is that from the outset Russia will be found sitting on a psychological volcano.

Not only do the Russian communications traverse hostile regions, which can be contacted prior to the outbreak of war, but vast numbers of Russian soldiers are recruited from the subjugated peoples within the U.S.S.R., who are at heart anti-Russian, and the loyalty of such troops toward Russia is unstable.

This human explosive, be it noted, is incomparably more potent and economically effective than any number of atomic bombs; for instead of blindly destroying friend and foe, it mobilizes the former for the destruction of the latter.

The main elements of the force here visualized are: (1) A tactical air force sufficiently powerful to gain local command of the air; (2) a defensive wing —the shield—composed mainly of heavy tanks, antitank units, bomber craft, and atomic artillery, which can delay an advancing enemy; (3) an offensive wing—the sword—organized and equipped to penetrate the enemy's front, preferably under cover of night; (4) a guerrilla wing, which will organize, arm, equip, and supply revolt in rear of the enemy, and (5) an air-carrier wing which, as occasion demands, will supply the forward troops and transport airborne ones.

This, in brief, is the type of war we should arm for. And seeing that in the now archaic year of 1940 it was possible for General Wavell with 31,000 men to defeat 180,000 and capture 130,000, with all the scientific knowledge and means now at our disposal there should be no need to doubt our ability to play the part of David in face of the Muscovite Goliath.

Finally, let us remember this: In scientific warfare, he who prepares for the defensive digs his own grave.

Army photo

A glimpse of things to come reveals more powerful, more accurate, and more flexible armament

Future Ordnance Will Have More Firepower and Mobility

Monte Bourjaily, Jr.

Associate editor, Army Times, Washington, D. C.

MANY of the weapons with which the American Army will fight in any future war were given general release in the publication of the Army's testimony on the 1954 budget before the House Appropriations Committee.

Some Now Ready

A few of the Ordnance development items described are already in the hands of user troops or soon will be. Others are three or four years away from troop use.

Official confirmation was given to reports that Army Ordnance's surface-to-surface guided missiles are being planned to carry nuclear warheads. The Army, therefore, has the capability of delivering tactical atomic explosions at a far greater range than the 20-plus miles of the 280-mm. gun.

In fact, the range of the 280-mm. gun itself is to be increased by the development of a subcaliber round which will add to the gun's present range by fifty per cent—more than ten miles.

The 280-mm. gun, according to Army testimony, is only one of four new pieces in a programmed 6-piece artillery family with which the Army is to be equipped.

The two next largest pieces in the family already exist. They are the 240-mm. and the 8-inch howitzers, described as very satisfactory weapons available in sufficient quantity to meet future requirements.

Replaces Two Guns

The 8-inch and the 155-mm. guns, however, are to be replaced. The replacement is to be a gun between these two in size. Since the 8-inch is a 203-mm. gun, this places the caliber of the new gun at something like 170- or 175-mm.

Next member of the new artillery family is called the 156-mm. howitzer. This is to distinguish it from the Army's present 155. Two versions of the gun are being built. The first is a lightweight piece in which weight saving is the principal difference between it and the current model. The second version falls between the present piece and the lightweight as far as weight classification is concerned.

The second version weighs more because it has the mechanism necessary to give it a 360-degree traverse—one of the Army Field Force requirements for a replacement for the current 155 whose traverse is limited to 60 degrees. Delivery to test boards of both models of the new 156 are expected to be made within two years.

Junior member of the new artillery family is the replacement for the 105-mm. howitzer, the work horse of World War II and still the main armament of

the U. S. Army's divisional artillery.

The new howitzer will be a 110-mm. weapon. It is now in its engineering development stage. Five of the new pieces are expected to be ready for research and development and field tests next year, with the first to be ready in May.

The 110, to quote Maj. Gen. Leslie E. Simon, Assistant Chief of Ordnance for Research and Development, will meet these objections to the present 105:

To Meet Objections

"Postwar studies show that it (the 105) has insufficient range. Instead of 12,250 yards' maximum range, Army Field Forces want more. The 105 has enough shell effect, but we have designed ammunition for this weapon (the 110) that increases the effect considerably. That is due largely to improvements both in the steel for the shell and in the explosive.

"The present 105-mm. howitzer lacks sufficient firing area. The user wants increased traverse in the new weapon. The present howitzer cannot be elevated far enough and has much less than desired accuracy. We can improve this accuracy considerably."

Improved traverse—a full 360 degrees—is possible now in the 156-mm. howitzer and the 280-mm. gun. It is not unreasonable to assume that it will be incorporated in both the Army gun (170- to 175-mm.) and in the 110-mm. howitzer.

But new artillery is only the beginning as far as Ordnance Research and Development is concerned. There have been advances in small-arms development, both for the rifleman and for aircraft.

A New Rifle

In the light-rifle field, the testimony revealed that the T44 lightweight is now the only American-made weapon left in competition. A new entry is challenging it, however. This is the Belgian FN, made by the commercial Belgian firm which makes the Belgian Army rifle. Both are designed to use the T65 cartridge. User tests of the FN and the T44 are now in progress. Results of these tests should be available this fall.

The light rifle, if adopted, will replace the caliber .45 submachine gun, the carbine, the present caliber .30 Garand, and the BAR autorifle.

Actually, it seems likely that three guns using the T65 cartridge will be made. With a heavy barrel and a 20-round magazine fed from below, the new rifle, possibly with a bipod attached, will replace the BAR. With a magazine fed from the top—a modification now being made in both the T44 and the FN at Field Force request—it will replace the carbine, the submachine gun, and the Garand.

A modification of the new rifle so that it will take a belt feed can turn it into a lightweight machine gun of only twenty pounds. This gun would replace all present caliber .30 machine guns, both air- and water-cooled, with a saving in weight of twelve to twenty pounds.

High-Speed Weapon

Small-arms development in the field of aircraft armament includes two weapons described in the testimony. One of these is a high-speed machine gun. It is designed to have a rate of fire such that in modern high-speed jet air combat a plane cannot fly between the bullets in the stream. Ordnance is known to have been working on caliber .60 as well as caliber .50 machine guns for the Air Force.

Biggest problem, which apparently has been solved, is to permit a high rate of fire without overheating or burning out the barrels. At speeds of over 600 miles an hour, the rate of fire must be well over 5,000 rounds a minute if the distance between bullets is to be less than the length of a modern fighter.

Second air item is the launcher gun for the 70-mm. boosted rocket projectile. This is a true gun, not merely a rocket launcher. It fires the projectile at a muzzle velocity of something like 1,000 feet a second. The 70-mm. shell holds a pound of explosive, sufficient so that a fighter can destroy a heavy bomber. The shell holds true to its course because it is itself a rocket as well as a shell.

Back in the field of land-combat items, we come to the BAT. Developed by combining the best qualities of models made by three different manufacturers—Frankford Arsenal, Firestone Tire & Rubber Company, and the Frigidaire Division of GMC—it is already in production, having been ordered in by retiring Army Chief of Staff, Gen. J. Lawton Collins.

The BAT

The BAT gets its name from the initials describing its job—battalion antitank weapon. It seems to be a high-velocity version of the 105-mm. recoilless rifle. Its design seems to have solved the problem of getting high muzzle velocity and the resulting flat trajectory for a recoilless rifle. According to the testimony, it can be mounted on a cart, can be man-transported, mounted on a jeep, or mounted on ONTOS.

What is ONTOS? Its name comes from the Greek. It is supposed to be Greek for "The Thing," although classical scholars may object that the grammer is off and that it should be called *ton onton*.

Mounted on ONTOS, the BAT gives the infantry battalion a highly mobile antitank weapon that packs a terrific punch. ONTOS is a combat vehicle, apparently light in weight and perhaps track-laying. Fourteen modifications of

The accompanying article is based upon facts disclosed by spokesmen for our Army before the Appropriations Committee of the House of Representatives at hearings on the budget for 1954. Here is part of the amazing record of phenomenal progress by Army Ordnance and American industry in the research, design, and development of new weapons.

It will be seen from this account that Army Ordnance under the leadership of Maj. Gen. E. L. Ford, Chief of Ordnance, has accomplished great things during the past four years. The new weapons, with their vast increases in firepower, reflect tremendous credit also upon American science and industry which are working in close harmony with Army Ordnance in the achievement of such masterful results.

It is especially timely to review the record and realize the extent, volume, and vision of the present effort by the Industry-Ordnance Team.—THE EDITORS.

the basic model have been designed and tested. The one mounting the BAT is going into production now and should be in the hands of user troops within a year.

ONTOS costs $36,000 as a vehicle alone. With BAT mounting, it costs $58,000.

Another version which will go into production within a year and will be delivered within two years is an antiaircraft vehicle. Final tests to iron out the bugs are to be given it during the coming months.

The antiaircraft version of ONTOS will mount the turret, now trailer-mounted, of the quad-50. Other possible versions would seem to include a troop carrier, a mortar carriage, and a general-purpose vehicle.

Speaking of armored troop carriers, orders for a new one are revealed—the T59. This vehicle is designed to replace the M75—formerly known as the T18—whose combat debut was recently announced in dispatches from Korea where it earned its nickname, "the Lifesaver."

The T59 is being bought from the Farm Equipment Company by Army Ordnance under instructions from Army Field Forces. Although replacing the M75, it is not a member of one of the tank families as are all other track-laying vehicles now being bought by Ordnance. As presently designed, it uses none of the parts that are in the T41 series of vehicles.

Cost Differential

Reason for buying the T59 instead of the Lifesaver is apparently cost. The Lifesaver costs $89,289 without spare parts, $132,031 with spare parts, although this cost may come down. The T59 costs only $38,551 without spare parts and $48,188 with spare parts.

On order or already delivered are 1,729 of the M75 Lifesaver. An order for 780 of the T59 at a total contract of $51,000,000 has been let.

Army Field Forces and G-4 have apparently decided that, in spite of the logistical problem in increasing the spare-parts load that Ordnance repair outfits and depots must stock as a result of the substitution of the T59 for the M75 and the breaking down of the "family of vehicles" concept which Ordnance has been building up since World War II, the savings in initial cost of the T59 over the M75 make the former a good buy.

Another vehicle in the T41 series, the T41E1 Walker Bulldog tank, is also no longer to be procured. It will be replaced by a newer "extralight" tank, according to the testimony.

"We are not producing any more of the present light tanks," said Maj. Gen. E. L. Cummings, chief of the Ordnance Industrial Division. "We will run out the production on present light tanks, and subsequent procurement of light tanks would undoubtedly be of this model if it proves successful."

The T41E1 with its 76-mm. high-velocity gun weighs twenty-eight tons. Armor has said that this is too much. Two of the new "extralight" tanks, on which no details are available, are being procured for field tests, in addition to four that are being built with Research and Development money.

90-mm. AT Gun

This tank is apparently not the same as the 8-ton airborne tank that is also mentioned in the testimony. In last year's testimony, reference was made to an airborne 90-mm. self-propelled antitank gun. With these two items, the fighting power of the airborne regiment is apparently being shored up.

Although the T41 is now obsolescent, the T41 family of vehicles will continue to be built. Base item in its production will be the T141E1, an antiaircraft vehicle. It will mount the standard twin-40-mm. turret on the T41 chassis and two caliber .50 machine guns.

"It seems likely that three guns using the T65 cartridge will be made. With a heavy barrel and a 20-round magazine fed from below, the new rifle, possibly with a bipod attached, will replace the BAR. With a magazine fed from the top—a modification now being made in both the T44 and the FN at Field Force request—it will replace the carbine, the submachine gun, and the Garand."

Several other Ordnance developments which are either about to be procured or are in development are also mentioned. One of these is a 4.5-inch rocket launcher with twenty-five tubes instead of the twenty-four now standard. It would have its tubes arranged in banks of five each, instead of in three banks of eight each, making a more compact weapon. Items such as firing tables, computing circles, and similar equipment are also mentioned.

New Engineer Items

A number of new Engineer items of interest to Ordnance are described to some extent in the testimony. These include various kinds of metascopes—infrared viewing devices—including a tank-mounted infrared searchlight and binoculars to be used in conjunction with it. Also described is a white-light searchlight designed for tank mounting. Its light comes from an improved incandescent tube. The diffusion is such that the vehicle on which it is mounted is hard to locate. It is so protected that it is in little danger from enemy fire. Biggest difficulty in keeping this device for nighttime illumination of the battlefield in operation is that it suffers under the shock of gunfire from the tank mounting it.

New bridges, including one for tank use in crossing deep narrow gullies, such as antitank ditches, and folding bridges which are tank-mounted and can be emplaced without exposing the men doing the work, are also mentioned.

New Signal Items

New signal items of interest include new IFF radios for use with the 75-mm. Skysweeper antiaircraft automatic cannon and for the M33 fire-control system. Also mentioned are two items for use by troops, one a radio system, developed out of Korean experience, which sets up outposts for sentries by providing a receiver for transmitters dug in at a distance from the sentry post, thus extending the range of the sentry's ears, and a ground radar set—the PSS-6—for protection against infiltration. This latter apparently is not affected by ground reflection, a problem some said was not likely to be overcome.

"ORDNANCE IN THE ATOMIC AGE"

will be the theme of the

THIRTY-FIFTH ANNUAL MEETING

of the

American Ordnance Association

to be held at

ABERDEEN PROVING GROUND, MD.

on

Thursday, October 8, 1953

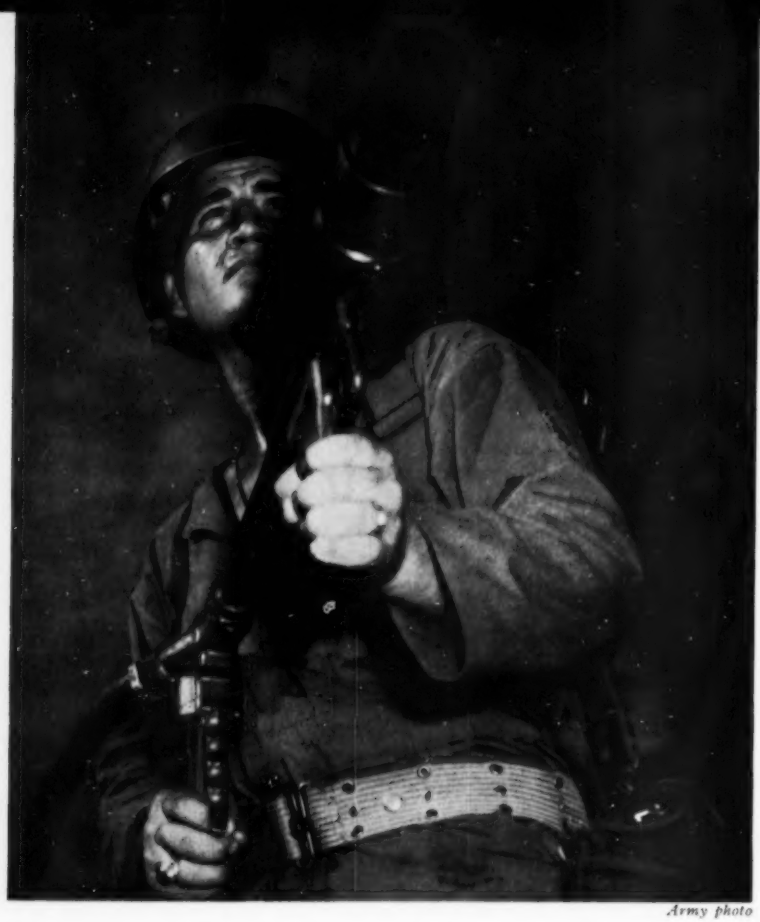
"Ordnance Day" at Aberdeen is always a real homecoming for the A.O.A. for it was here that the Association held its inaugural meeting in October 1919.

Every member who can possibly do so will be present this year to witness the day-long schedule of tests and demonstrations of the modern weapons of our fighting forces.

Complete details of the meeting, including reservation forms and transportation information, have been mailed to all members. Reservations will close October 1, 1953

Only Association members may attend the meeting. If you have any friends who wish to come, see that they become eligible at once.

ORDNANCEMEN, ON TO ABERDEEN!



Army photo

Combat Effectiveness

Killing Power, Not Firepower, Is The Final Criterion in Any Battle

Maj. James W. Campbell

SINCE World War II, "firepower" has become almost a household word. It is a favorite topic of writers, armchair strategists, and self-styled military experts. It is such a colorful word that even junior space cadets and cap-pistol-toting Hopalong Cassidys now use it to determine the winners of interplanetary wars and cowboy and Indian battles.

Two Meanings

To virtually all civilians, grown-ups and children alike, firepower simply means combat effectiveness. But to military men who coined the word, firepower has an entirely different meaning. It stands for maximum capability of weapons.

There is a wide gulf between the two definitions, but failure of most civilians to understand that has led to endless debate, ridiculous assertions, and unfounded charges that backward Iron Curtain countries are able to organize better fighting forces than the greatest industrial nation in the world.

Millions of Americans were shocked last year when a Senate Armed Services subcommittee launched a blistering attack on the Army, charging that it was wasting manpower in its fighting units.

"The Soviet division has ten per cent more firepower than the American division," the report said in part. It concluded with a statement that "we cannot consider a division efficiently organized when a potential enemy division can outgun it by ten per cent on a man-for-man basis."

Look at Korea

The subcommittee apparently had assumed that firepower was combat effectiveness. Killing power had not been considered. But all the Senate investigators would have had to do to compare the combat effectiveness of American divisions with Soviet divisions would have been to look at Korea, for the Red divisions of North Korean and Chinese Communists are organized exactly as Russian divisions are organized. They were trained by Russians and they are being supplied by Russians.

Nearly three years of fighting in Korea have proved that firepower alone is not enough to win a war.

The Communists in Korea had more guns and more men than the United Nations forces which fought them to a standstill. Even on a man-for-man basis, Red divisions in Korea are capable of throwing more hot lead and steel than American divisions.

Twelve-to-One Ratio

But while the Reds are long on firepower, they are short where it counts—in killing power. American forces alone have taken a toll of nearly a million and a half battle casualties among the Communists while suffering approximately one hundred and thirty thousand—a ratio of twelve to one, which not even the Chinese, with their vast reservoir of manpower, can stand indefinitely.

If firepower alone would win wars, America never would have won its independence from Great Britain. Early American forces were badly outgunned

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by the British, but General George Washington himself noted that the Redcoats were unable to capitalize on their superiority.

The British difficulty was lack of mobility. Battles in 1776 often were fought on broken ground that was inaccessible to British artillerymen whose unwieldy guns often weighed 3,200 pounds or more and required a team of twelve horses to pull them into position.

Because of their lack of mobility and extremely short range, these brass or iron cannon often could not be brought to bear on Continental Army musketmen. As a result, the British guns frequently were useless.

Red guns in Korea also were useless much of the time, not so much because of lack of mobility but because of lack of control by Red commanders. One of the most outstanding weaknesses of the Red war machines in Korea and in Russia is poor communication. The Communists—who have found that a combat unit without communications is like a muscle without nerves—now are trying desperately to copy the U.S. Army signal system.

The Communists in Korea have suffered frightful losses in pressing attacks that should have been called off. But they were unable to stop them because of poor communications.

North Korean and Chinese artillery units often were limited to prearranged fire missions, for forward observers could report and obtain fire on targets of opportunity.

Red infantry units are unable to obtain rapid counterbattery fire so necessary to neutralize punishing U.S. artillery action. Reduction of break-throughs and surprise attacks are left to units in the immediate vicinity, resulting in tremendous and unnecessary losses.

American attacks against strongly fortified bunkers have met with amazing success, not only because of superior U.S. Army tactics but also because the Reds are unable to get artillery and mortar support on call. Even when Red commanders see an attack developing, they seldom can shift their guns fast enough to meet the situation.

Radio and wire communications hardly exist below battalion level in Soviet-type armies, and at higher headquarters they are primitive by American standards. The Reds never have attempted to use close air support—probably because they have no troop-to-plane contact. Direct communication between U.S. soldiers and fighter pilots brings close air support to American units in a matter of minutes.

Few Telephones Found

Since the war began in Korea, American soldiers have captured hundreds of thousands of tons of Red equipment, but found only a few telephones.

U.S. Army artillery is the most flexible and most powerful the world ever has known. It is the last word in effectiveness due to fast, reliable communications, the world's best weapons, and highly skilled gun crews.

Unlike Communist artillery, American guns put their killing power to work where it is needed with lightning-like speed. When a U.S. forward observer calls for "time on target" fire and describes his objective, a highly specialized organization of communications and fire-direction experts goes into action.

"Time on Target"

If the target warrants it, the artillery of an entire corps—on the average perhaps 270 guns ranging from 105-mm. howitzers to 8-inch rifles—can be concentrated and fired at such carefully calculated intervals that all projectiles strike the target at the same instant. The result is mass destruction and death—killing power. Yet, man for man, the Reds in Korea have more artillery firepower than the U.S. Army.

A "TOT" (time-on-target) mission is simple for U.S. artillerymen. But it is impossible for Red armies the way they are organized and equipped today. At present, fifteen per cent of a U.S. infantry division's personnel is assigned to communications. To reduce it would be to hamper the effectiveness of present U.S. techniques and to abandon one of the most favorable factors that have made the American combat team a winning force.

Twelve per cent of the Red division's personnel is assigned to communications now, and if the Communists' efforts to improve their signal systems are successful the three per cent differential will be closed and probably exceeded.

Rapid communications make it possible for this 155-mm. howitzer to plant its fire where it is most needed (Army photo).

Infantrymen open up with light machine guns on opposing forces during recent maneuvers at Ford Ord, Calif. (Army photo).

A 75-mm. recoilless-rifle team waits for the signal to offer support fire to other units of its regiment (Army photo).

Some critics who have harped about firepower have pointed out that a U.S. division has nearly eighteen thousand men while a Red division has only eleven thousand. But few if any have pointed out that the Reds use three or more divisions on the same front occupied by one U.S. division.

Nor do they point out that this difference of approximately seven thousand spells the difference between a self-contained unit built on democratic, humanitarian standards and a division with limited capability which is built on standards that border on barbarism.

A study of weapons and vehicles available to a Communist infantry division shows that it is not a balanced team of combined arms. It is weak in services and has no internal replacement system. As a result, it is dependent on nonorganic support for sustained operations.

Transport Lacking

Transportation was a basic weakness of Russian divisions during World War II, and this same weakness has shown up in Red armies in Korea. One of the most painful lessons the North Koreans and Chinese have learned is that adequate motor transport is vital to sustained operations, for an extreme shortage of trucks forced almost unbelievable hardships on the Communist armies.

Virtually every Red foot soldier who crossed the Yalu River from Manchuria had to walk most, if not all, of the way to the front—400 or more miles. Every vehicle that could roll under its own power had to be used to supply more than one million Communist troops at the front.

After marching this distance by night—to move in daytime was to invite death from American planes which roamed the skies at will—"fresh" Chinese Communist troops arrived in the battle zone footsore, bone-weary, and lice-ridden.

Many, who started their long hike in the bitter cold of winter, arrived in the combat zone after the spring thaw. Their heavy winter uniforms added to their discomfort.

American air attacks have taken an astounding toll of Red motor transport, but air attack was not the only reason the Red supply system had difficulty. The vehicles and the roads of North Korea were not up to the job that had to be done if a Red offensive was to be sustained. Overturned trucks and breakdowns that blocked traffic for hours presented an unending problem. Vehicles failed to stay on the road on downhill curves because of defective brakes. Crudely constructed bridges collapsed under the steady strain of heavily laden trucks.

Underpowered vehicles found the going tough in the North Korean mountains. They were short of engine power and they lacked traction. Two-wheel drive was commonplace where four- or six-wheel drive was needed.

Just as vehicles were scarce, so were competent drivers and mechanics. Many vehicles were deadlined because of relatively minor troubles.

American Arms Best

Korea has proved again that individual arms of American soldiers are the world's best and are far superior to Russian weapons. The jamming of guns, rarely a factor in the U.S. Army, has proved a serious problem for the Reds in Korea. Each Red rifleman carries a cleaning rod, and its primary purpose is to drive stuck cartridge cases out of the gun chamber.

The Reds also have good reason to question the value of two weapons in which they have placed much faith—the submachine gun and the "potato-masher" grenade.

By allotting 2,997 submachine guns to each Red infantry division (a U.S. division has 970), the Communists beefed up their firepower "points." But this has failed to pay off in killing power. The weapons are accurate only at very short ranges, and keeping ammunition on hand for them is an almost impossible job, for they use cartridges at the rate of one thousand a minute.

The Reds have made liberal use of the potato-masher grenade, and it is the only weapon of thousands of Chi-

Forward observers in a radio-equipped jeep direct artillery fire on enemy troops. Smooth teamwork and good communications like this give the American forces the advantages of concentrated fire (Army photo).

nese and North Korean Communist soldiers. It is a handy weapon with a powerful blast effect, but American soldiers have found it has far more bark than bite.

Grenade Not Effective

Literally tens of thousands of these hand bombs have been thrown at American troops, but the number of deaths and wounds they have caused is much smaller than is generally believed.

Fragments usually are very small, and rarely have American soldiers suffered more than minor cuts and bruises or concussion injuries from them. The explosion usually pulverizes the thin cast-iron casing, resulting in a small amount of killing power.

The Communists have made extensive use of mortars in Korea and, while they have inflicted many casualties, their killing power is far below that of American mortars. The Red mortars have little flexibility and usually have been able to cover the ground only to their immediate front. U.S. mortarmen, who can shift fire to any point rapidly, can cover effectively the same ground that would require the efforts of several Russian mortar platoons.

Mortar "Invented"

Since the war in Korea began, the Russians have "invented" a 60-mm.—a weapon which is almost identical with the U.S. mortar. Quantities of this weapon were sent to the Chinese and North Korean Communists—but they were afraid to use it because of the unstable ammunition the Russians supplied. When the projectile was dropped into the tube, it was as likely to explode then and there as it was later atop a UN position.

Guns Exploded

Many Red artillery pieces also have blown up, killing the gun crews, because of basic faults in design of the weapons. They are not built to withstand a big overload as are American artillery pieces.

Russian inventive genius has come up with a 57-mm. recoilless rifle—identical with that which American troops have been using in Korea almost since the Red invasion. But as yet the Reds have not matched the other two "hip-pocket" field guns of the U.S. Army.

Infantry units spread out after being transported to the combat zone by helicopter (Army photo).

These—the 75- and 105-mm. recoilless rifles—combined with the 57 have given U.S. infantrymen their own artillery in battle. They no longer have to call on artillery to fire on targets of opportunity or to reduce bunkers every time a little "big stuff" is needed.

Failure of the Reds to keep American fighter planes and Army liaison planes out of the area over the battle zone has helped to limit almost all Communist attacks to night actions.

Our Army patrols were prowling in the no man's land between the front lines every day from before dawn until after dark. But daylight patrols by the Reds were out of the question. Only at night could they escape death from the skies in the form of machine-gun bullets, burning napalm, bombs, or artillery or mortar shells.

This means their attacks had to be made in the darkness over unfamiliar ground. The result often was confusion. Proper timing—essential for a successful attack—was all but impossible. Surprise Red assaults often turned into piecemeal commitment of troops, and almost with the firing of the first shot searchlights, trip flares, and burning napalm illuminated the battleground.

With Red troops silhouetted against the skyline, the outcome of these engagements rarely was in doubt.

Soldier against soldier, the American fighting man is more than a match for the Communist enemy. He carries into battle more skill and killing power than his Red adversary. Even in firepower, the American outweighs the enemy when the comparison is made strictly as soldier against soldier.

Numerical Superiority

It is not until a comparison of battalions or higher units is made that the Red superiority in firepower—not killing power—shows up. In a U.S. infantry battalion of 887 officers and enlisted men there are 155 whose primary duty is not firing at the enemy. This is approximately 17 per cent.

The Red battalion of 618 officers and enlisted men has 85 noncombat officers and soldiers, or 12 per cent. The five per cent difference pays off many times for American infantry battalions.

The largest single noncombat element of a U.S. infantry division is its medical service, which totals about one thousand officers and enlisted men. The effectiveness—and morale value—of this service is unquestioned.

Deaths from battle injuries and wounded have been reduced to 2.4 per cent of all those reaching medical care. This compares with 4.5 per cent in World War II and 8 per cent in World War I. Returns to duty among wounded in Korea total 85 per cent.

A Red division has only about one-fourth as many medical personnel. It has no company aid men. Instead, riflemen are designated as aid men "in addition to other duties" in each platoon. Their medical training is very limited, but even if they were graduate physicians they likely would not be free of their fighting mission in order to treat wounded comrades. At Red battalion aid stations, enlisted men with limited training—not physicians—care for wounded as best they can.

A fundamental difference in the supply requirements of the American and Soviet soldier lies in the fact that the American is accustomed to a higher standard of living. In Korea, virtually all U.S. soldiers are receiving at least two hot meals a day.

American soldiers never would accept the regimen to which Communist soldiers are accustomed, nor will the Army or the American public ever ask them to accept it. When a group of American soldiers were fed a typical Russian diet for a single day as an experiment, they rejected it with the unanimous comment, "It's terrible."

"Some critics who have harped about firepower have pointed out that the U. S. division has nearly eighteen thousand men while a Red division has only eleven thousand. But few if any have pointed out that the Reds use three or more divisions on the same front occupied by one U. S. division.

"Nor do they point out that this difference of approximately seven thousand spells the difference between a self-contained unit built on democratic, humanitarian standards and a division with limited capability which is built on standards that border on barbarism.

"A study of weapons and vehicles available to a Communist infantry division shows that it is not a balanced team of combined arms. It is weak in services and has no internal replacement system. As a result, it is dependent on nonorganic support for sustained operations."

More Service Troops

A U.S. combat division always will have more service troops than a Soviet-type division. American soldiers have access to mobile shower baths and laundries, and they are supplied with many "little things" such as razors and blades, cigarettes, towels, toothbrushes, and toothpaste.

Manpower could be saved by eliminating these services, but to do this would cut down the combat efficiency—the killing power—of American fighting outfits.

There are many soldiers in a U.S. division whose primary job is not firing at the enemy. That is because the U.S. division is a highly technical fighting machine. These men all contribute to a balanced team of arms and services and are required for its efficiency.

But when the occasion demands it, cooks, bakers, truck drivers, mechanics, and mail clerks pick up weapons in which they are thoroughly trained and give an excellent account of themselves in battle. Thousands of these so-called "noncombatants" have won their Combat Infantryman Badges the hard way—in battle.

Moves Faster

Because of its organization, the U.S. infantry division moves faster, gets into action quicker, kills more efficiently, and sustains itself longer in combat than any other army anywhere in the world—on either side of the Iron Curtain. It has the most killing power—and that's what counts.

Russia's best World War II tank, the Joseph Stalin III (Sovfoto).

New Soviet Arms?

"Families" of Powerful New Weapons May Exist behind That Iron Curtain

Garrett Underhill

ARE we living in a fool's paradise? Some of the West's most competent authorities on the Soviet Army think it's all too possible—even likely.

They fear that Americans are too complacent about their army-type armament and how it stacks up against the Soviet Army's weapons. In particular, they point out that the way Americans make comparisons between U.S. and Red weapons shows that too many Americans fail to fathom the real nature of the Reds' present position as to army arms.

May Surpass Us

It shows that Americans still tend to give themselves credit for being able to make progress while failing to appreciate that foreigners often have had the better of us in the past and may well excel us in the future.

For some years now our tendency has been to compare America's new (even projected) weapons with those the Reds are known to have in general service. Thus the new Patton medium tanks are matched against the Reds' medium T-34; the U.S. heavy T43 tank is compared to the Reds' Stalin.

U.S. officials have derived startling satisfaction from such comparisons. They have issued statements assuring the American public that the Patton 48 is "the finest tank ever built" and that the T43 "will outslug any land fighting machine ever built."

The fact is that it would be a national scandal if the U.S. "family" of tanks standardized since Korea failed to compare most favorably with the Reds' Stalin and T-34. *For the Red tanks belong to a family which not only antedates the current U.S. family of tanks: the Red tank family actually antedates the U.S. tank family designed and used in World War II.*

Early T-34 Production

Morosov mocked up the T-34 tank in March 1937, as the T-111 (T-46-5). The T-34 was in production in 1939, in service in 1940, and in action against the Germans when Hitler attacked Russia in June 1941. The main U.S. World War II tank (the M4 Sherman) was adopted after that date. It was a revision of the M3 Lee, the characteristics for which were firmed up on June 13, 1940.

Used Against Germans

The present Red T-34 (with 85-mm. gun instead of a 76) went into production in 1943 and into action in Romania against Manteuffel's Gross Deutschland Panzer Division in May 1944. Our Sherman tanks, armed with a 76 instead of a 75-mm. gun—the "Easy Eights" which have been the main work horses in Korea—didn't come into action until the latter part of 1944.

The present Stalin tank (the III, or "turtle-backed" version looking somewhat like the U.S. Patton 48) is a remarkable redesign of the KV heavy tank which Kotin designed in 1938-1939. The big Kirov plant in Leningrad produced the first KV's in time for action against the Finns' Mannerheim Line in the 3-month "Winter War" of 1939-1940.

In 1943, safe in the Urals' fastness, Kotin put into production the thoroughly revised KV known as the Stalin I and II. These entered action with the T-34 85's. The next year—1945—saw the equally thorough Stalin III revision in action in Poland.

The Pershing Tank

In contrast, the heavy U.S. Pershing tank (although readied in prototype form by Army Ordnance in August 1942) was for so long spurned by Army authorities that Pershings got into action only in February 1945.

The Reds' T-34 and Stalin tank designs are thus fourteen to sixteen years of age. They're old stuff. Instead of deriving intense satisfaction by comparing our 1950-1951 tanks to these patriarchs of the tank world, Americans should be worried. They should be gravely concerned as to what bald-headed Moro-

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sov and balding Kotin have been developing in the way of new and original tank designs, since they surprised the world years ago with their original T-34 and KV designs.

Certainly it would seem to the highest degree unwise to assume that all these comrades have been doing is losing their hair and swilling vodka. Westerners can fervently hope that these Reds have been doing just that, but they'd be fools to count on it.

True of Other Weapons

What's true of Soviet tanks holds true for the vast majority of the other Soviet army weapons. Basically, they date from before World War II—or even from before World War I—although in present form they may represent radical revisions made during the Reds' battle against Germany and her allies.

The field and antitank artillery (on which the Reds pride themselves and of which they have such immense quantities) have as their "latest-date" designated weapon an M1944 100-mm. gun. Ostensibly this is a novel-type corps medium gun which also doubles as a powerful antitank weapon. Actually it is a World War II conversion of a Red navy dual-purpose (surface and flak) 100-mm. gun of the early 1930's.

Production for the army was made possible when the German ring around Leningrad was broken in 1943. Production of such a gun was undertaken because the Germans' big Panther and King Tiger tanks began to loom on the armament horizon.

The Reds' "new" wartime 85-mm. antitank gun is, of course, their M1939 flak gun adapted to AT use. The most common Red antitank and field-artillery weapon—the light M1942 76-mm. gun so often seen in Korea—is nothing but their M1939 field gun on a light, cheap, easy-to-make, tubular-trailed carriage. As for the common M1943 57-mm. antitank gun, it's the M1941 57 on the 76's 1942 carriage.

Other common Soviet field artillery acutally carries pre-World War II designations. In this class of weapons are the remarkable 122-mm. M1938 light howitzer (division artillery standard still), the ubiquitous 152-mm. M1937 gun-howitzer (most common corps artillery weapon), and the 122-mm. M1931 gun (which is mounted on the 152's carriage as the M1931/37).

While these last corps pieces often have been altered for high-speed truck draft during and since World War II, the lumbering 203-mm. howitzers of 1931 use the old, slow farm tractor draft carriages with which they were fitted more than twenty years ago. So does their companion piece, the powerful 152-mm. M1935 gun.

The Reds' commonly displayed mortars (with which some Americans smugly compare U.S. mortars standardized in February 1951) were remarkable for their day, but their day was fifteen years ago. At that time the Reds made mortar history by producing their Korea-terror (the 120-mm. M1938) as a weapon for the infantry regiment.

U. S. Heavy Mortars

Not till after World War II did the U.S. adopt heavy mortars as regimental infantry weapons. During the war the U.S. 4.2-inch (107-mm.) Chemical Corps mortars got this job by improvisation.

The Reds have a so-called M1943 120-mm. mortar, but it is so similar to the original 1938 model that most people could hardly tell the difference.

The same applies to the Reds' 82-mm. "battalion" mortars of 1943 and 1941: they're revisions (for wartime mass production and general handiness) of the M1937 82-mm. that the Reds got from Finland's Tampella people. (That's where they got the ideas incorporated in the revolutionary 120, too—which makes the basic origin of these Red mortars even earlier in date than is indicated by their model designations.)

A Retrogression

Soviet small arms (rifles and machine guns) standard since V-J Day actually represent a retrogression from the Red position just before World War II. Then the Reds were trying to introduce semiautomatic rifles, as America did with the M1 Garand. But Tokarev's rifle of 1940 failed the test of war, and its manufacture was abandoned in 1943.

The old M1891/30 rifle superseded it completely. Since the war, the standard rifle has been a cut-down version of the 1891, misleadingly designated the "M1944 carbine."

Similarly, during World War II Degtyrev's M1939 heavy machine gun failed. It was superseded by the reliable but cumbersome old water-cooled Maxim M1910 "samovar."

True, the Soviets have since tried to push the air-cooled M1943 Goryunov, but there are plenty of pre-World War I model Maxims around. They evidently remain great favorites with the infantry whose conservative peasant view seems to be that what was good enough for father and grandfather is good enough for them. (As Model 1903's, the Maxims were used in the Russo-Japanese War fifty years ago!)

The principal Soviet pre-World War II small arm which didn't fail in combat was the "DP" light machine gun. But though still in use, throughout its 23-year life it has been under constant criticism from the troops themselves.

The "Burp Gun"

As for the famous "burp gun," it's admittedly a 1941 rush job slapped out in a few months by George Shpagin. It's well-adapted to production by unskilled peasant labor working in cave factories but hardly the "machine carbine" the Soviet mechanized and light infantry want.

All in all, then, the Soviets' widely known army armament—especially that encountered in Korea—can hardly be described as sizzling hot off the designers' drawing boards.

With these facts at hand, even a layman could rightly conclude that the Soviets' army weapons are overdue for replacement with new and more satisfactory modern models.

Unfortunately, an inept Western approach to post-V-J Day Soviet military programs has helped to obscure the true Red military picture. It has been asserted that the Reds have been embarked on an all-out rearmament pro-

gram since the Cold War began in 1947. It has been proclaimed that the Reds have been turning out thousands upon thousands of tanks and quantities of other army-type armament.

Old Equipment Used

This has not been the case. Many U.S. officials as well as citizens would be quite surprised to learn, for instance, what most Austrians know, who can't help but notice the equipment which the key Soviet striking forces there still have. For the "unconcealable" motorized equipment includes Lend-Lease 6-by-6 Studebaker and Dodge trucks and ancient White M3 scout cars and the Diamond T half-tracks (with 57-mm. gun) abandoned by the U.S. Army early in World War II.

As time goes on it becomes ever clearer that after World War II the Soviets found themselves in a weapons situation much like that of 1927 when they began their first great rearmament drive under their now-famous Five-Year Plans.

In 1947 as in 1927, the Soviets had many satisfactory models to fill many common categories of army weapons. They had the tooling to make them, too. Especially when slightly modernized and improved, these old models could be made to do for some years to come.

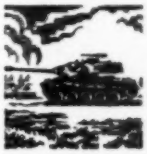
In 1927 the Soviets found that their real rearmament problem was that of creating entirely new-type weapons which the rapid spurt of sciences during World War I had brought into being.

Production Limited

Because their industrial backwardness had made them concentrate during World War I (and the Civil Wars which followed) on extant types of arms, they hadn't been able to initiate significant wartime production of the new weapons types as had the West. In 1947 it was the same: World War II had ushered in even greater advances in weaponeering than World War I.

Therefore in 1947 and in 1927 it behooved the Soviets to "make do" with the old-model army weapons in the conventional weapons categories, while they went all-out to fill the gaps which the wartime advances of science had created in their weapons systems.

The Soviets could afford to allot industrial effort to replace old-model conventional categories of weapons only when the critical gaps began to be well filled.



To get the hang of current Soviet rearmament, it is obviously necessary to learn how the Soviets handled their 1927 rearmament problems.

In 1927, the Red Army found itself with a pretty good rifle and heavy machine gun left over from the Czarist era: the Mossin rifle of 1891, the Maxim machine gun of 1910. Plenty of production capacity had been built up for these in World War I, although too late.

No Light Machine Gun

But the Czarist Army had not had in production a light machine gun (automatic rifle, by U.S. terminology), nor had it made any real effort to produce trench mortars. The Czarist army also lacked antitank weapons.

So the Reds merely improved their old Mossin rifle as the M1891/30 (for 1930). They made minor changes in the Maxim machine gun and tried to introduce a new M1931 mount.

To provide the new-type weapons the Czarist army lacked, the Soviets went to the Rheinmetall firm for the German Army's 37-mm. antitank gun (which they adopted as the M1930 but soon boosted to 45-mm. caliber (as the M1932). From France's Edgar Brandt they got the "world standard" medium mortar like the U.S. 81-mm. but upped its caliber to 82 mm. as their M1931.

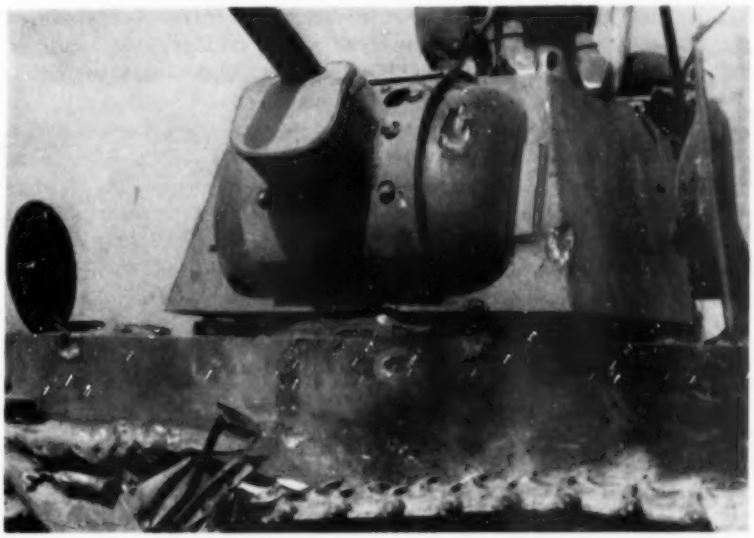
Similar Policy

The Reds followed a similar policy with field artillery. They had the native M1902 76-mm. put out by the Putilov (now Kirov) plant and rated by the Germans and Austrians as better in World War I than the French 75. They had 122-mm. light howitzers and the 152-mm. medium howitzers designed for the Czars as M1910's by France's Schneider firm. But lacking was heavy artillery and a long-range medium gun.

The Reds solved their artillery problem by modernizing the Putilov "76" (and the 122 and 152 Schneider "how's") as "slant 30's," as in "M1902/30." Modernization included larger powder chambers, longer range, and—in some cases—high-speed axles for truck instead of horse draft.

Meanwhile the Reds developed a Skoda-type 203-mm. howitzer (same caliber as the U.S. Army's 8-inch one) as an M1931 and beefed up a Czarist Schneider-type 122-mm. piece known

German tank and antitank guns failed to penetrate the armor of this Russian KV I heavy tank in 1941 but lack of fuel caused crew to abandon it.



as the M1931 long-range medium gun.

But overriding the effort to better infantry and artillery armament was a gigantic effort to develop matériel to fill the critical categories of munitions practically nonexistent under the Czars. These categories included not only tanks and aircraft but automotive vehicles of all types.

And along with the development effort went preparations to build up production capacity, climaxing in increasing mass production of adopted new-type weapons.

New Army Weapons

When this production became an accomplished fact, there began to appear new-model army weapons to replace the modernized models dating from before World War I.

The Soviets' position in 1947 was actually far better as to Army arms than it was in 1927. The line of proved conventional Red arms extant in 1947 was in many ways outstanding. The Soviets not only had masses of these weapons left over from World War II but had plenty of production capacity for them. Moreover, when modernized, some of these weapons could be made to compare most favorably with what the West had left from the wars. T-34 tanks when fitted with 85-mm. gun turrets instead of 76-mm. ones became most formidable, as did earlier Stalins when rebuilt.

The German World War II invasion had done grave damage to industrial facilities, but, even so, 1947 Russian

industry wasn't the "morass" and "eyesore" Defense Commissar Voroshilov had termed it in 1927. Then Soviet rearmament had to start practically from industrial scratch; whereas in 1947 the new Soviet rearmament program could be based upon the results of three Five-Year Plans, a vast wartime industrial expansion primed by America, and the postwar exploitation of Eastern Europe.

Starting practically from zero in 1927 had been a great handicap to arms development. Due to the extreme lack of engineering know-how (particularly of production engineering), Soviet au-

A T-34 tank with 85-mm. gun passes on its way to a Red Square review (Sovfoto).

thorities were generally loathe to let native designers try original designs—or try to design to meet the ideas of the Soviet combat forces. They feared that too much time would be wasted getting the bugs out of native models. Hence proved foreign arms designs had to be accepted, even if they were semi-obsolescent.

Our Designs Used

In 1947 this was no longer so much the case. Intensive training and experience under the Five-Year Plans had enabled the Soviets to let their engineers introduce their own radical designs even before World War II. Thus the tank industry (completely new in 1920) had been allowed to standardize on the native and very radically designed T-34 and KV tanks in 1939-1940, despite the novel features of torsion-bar suspension and armor castings which some in arms-starved America then thought impractical.

But most important was the fact that Soviet engineers had made the most painstaking study of American production methods. This study was much amplified by World War II contacts. While still a prime deficiency, Soviet engineering and production know-how was at a far higher level in 1947 than in 1927.

A fallacious concept current in America is that the Soviets had much to gain from the Germans after World War II. The fact is that the Soviets' prime need has been production know-how for which she has looked to America in general and Detroit in particular. The Germans, who for centuries have been aiding Russian industry and who, despite Hitler, pitched in heavily to help the Five-Year Plans of the 1930's, have generally been held by the Reds to be too bound up in old-fashioned methods.

Learned from U.S.A.

The Germans, too, have had to learn from the U.S.A. what Europeans term "series" or "rationalized" production. What the Germans need is what the Reds need: to learn how to produce goods fast, make them cheap, and yet make them reliable and durable.

It hasn't been German help but two great American-administered "shots in the industrial arm" which have enabled Soviet industry to achieve what it has. The first "shot" was that given mainly during the first Five-Year Plan; the second was that given by World War II Lend-Lease under which industrial aid was far more important than actual armament shipments.

Even the need to reprocess most World War II army arms wasn't too much of a burden to the Soviets. World War II arms hastily produced in slap-dash fashion

(generally because of a very short combat life expectancy) did need considerable rebuilding. Axle-bearings on gun carriages were often bad; tank armor often was substandard (sometimes enough to make Hitler think the Reds were on their last legs), and the war had forced the use of many ersatz methods and materials. Cannon-tubes needed relining, too.

Arsenals Kept Busy

But under the Soviet peacetime preparedness system the basic arsenals have to be kept busy enough to retain and satisfy their engineering and labor cadres. "Stand-by" armament production lines are an old story to the Russians.

Nevertheless, in 1947 the Soviets faced grave problems in filling the gaps caused in their weapons systems by World War II advances in science and technology. The need for atomic energy for weaponeering and propulsion

called for a tremendous and complex effort; so did that to obtain military electronics in all its varied forms.

The revolution in fire control of weapons effected by wartime electronics progress actually must have been a terrible shock to the Reds. Before World War II they had gone to great trouble to create top-notch production of visual-type fire-control instruments for their navy only to find early in the war that radar had rendered this gear and the industry to make it obsolete almost overnight.

Equally shocking must have been the development of super-high-speed jet aircraft with the high-quality construction and materials they require. The jets threw into the junkpile the vast industry the Soviets had slaved to build up to produce rough-and-ready piston-engined aircraft made of tubing, plywood, and fabric.

Consequently, as they did in the early 1930's, the Reds after World War II very evidently attacked the problem of weapons "gaposis" with everything they had. And they produced surprising results.

Certainly they surprised many U.S. experts. The U.S. public was often assured by our authorities that the Joint Chiefs of Staff estimate for the Reds having atomic bombs was 1952. They were told that this estimate was based on the most thoroughgoing intelligence research. It was no wonder that America was rocked by President Truman's announcing the first Red atomic detonations in the fall of 1949.

That same year the U.S. Air Force assured Congress and the public that it knew what it was doing when it invested heavily in the piston-engined B-36 bomber. The Air Force then asserted that the B-36 wasn't slow and vulnerable to jet fighters as U. S. Navy authorities claimed.

The Air Force went so far as to cut back the North American order for F-86 swept-wing Sabrejet fighters to get more money for the B-36 program. It openly admitted that summer that it had only fifteen Boeing B-47 all-jet swept-wing bombers on order.

MIG's Appeared

Two years later Red swept-wing MIG-15 jet fighters slammed into well-escorted B-29 piston-engined bombers over Korea's Namesi airfield. The results sent U. S. Air Force Chief of Staff Gen. Hoyt S. Vandenberg hurrying to Korea.

The General (who himself had been worried by the lack of "jetization" of our bomber force) took stock of the MIG threat. He announced flatly that henceforth he "wouldn't use a piston job if he could help it" on bombing missions.

Simultaneously the transsonic, swept-wing MIG's performance in Korea had further shocked the free world by clearly making obsolete for air-to-air combat America's F-80 and F-84 straight-wing jet fighters.

This was most serious. The U.S. Air Force had invested the vast majority of its post World War II fighter funds in these straight-wing models. It has been arming NATO allies with them, too. Not only that, as General Vandenberg warned the public with exemplary forthrightness, the MIG proved that in some respects it excelled its U.S. counterpart, the F-86.

Rapid Development

But the MIG's main and nastiest surprise for our experts was the way in which the Reds had slammed it through development and into amazingly large-scale production. From all evidence it is now apparent that the MIG was begun a couple of years *after* the U.S. Sabrejet. Moreover, the MIG didn't go into full production until the spring of 1949, long after the Sabre was on order.

Ironically, the giant No. 1 aircraft plant at Kuibeshev was thus well on the way to grinding out MIG's in the fall of 1949 when the U.S.A.F. was grinding down its Navy colleagues for terming the B-36 too slow. Yet, despite its late start, the MIG has poured out in such quantities that, during 1950-1952 at least, the MIG has enabled the Reds—according to the U.S.A.F.—to keep 3-to-1 odds over America in jet aircraft.

Indeed, early in 1953 the situation was still so bad that when Red MIG's trespassed into the West to shoot up U.S. planes after Stalin's death, four out of five U.S. fighter wings in Europe were admittedly equipped with straight-wing, nontranssonic jets. With the MIG, the Reds redemonstrated that when they act, they act fast and slam things through.

U.S. experts also seem to have been taken a bit aback by ever-increasing evidence of the Reds' rapid build-up of electronic defenses. The quick interception of U.S., British, and Swedish "air pirates" when they near Soviet frontiers has testified to the Red early-warning and fighter-control system against aircraft.

This Red action has contrasted with U.S. officials' 1947-1948 assurances on

Below, a 2½-ton truck displayed at an exhibition of Soviet autos in 1942 (Sovfoto).

Red backwardness in military electronics. The gunnery radar that the Reds have let foreigners see in Russia undermines any hopes that the cruder flak radar the Reds use in Korea is the best they have. And there are various other odds and ends to indicate that the Reds haven't done too badly in the electronic field.

But upsetting to the West's complacency as Red electronic and atomic-energy capability has been, it's the MIG development which—coupled with the past history of Red arms—should make Americans think twice about slicing defense budgets. It should make them worried rather than complacent about the future standing of their extant armament.

The MIG also gives us another and most shocking lesson—that the West must not underestimate Red design genius and production capacity and efficiency. And it warns us that we aren't safe if we try to judge the Reds by past performance in any given line.

For with the MIG the Reds have shown us that they have overcome what looked for a generation like an insurmountable Soviet problem: the production of efficient aircraft engines.

More than that—certain features of the Reds' copy of the British Nene jet engine indicate that the Red designers have been smarter than the Anglo-Americans in finding solutions to certain combustion problems.

But the mass appearance of the MIG—topping the Reds' known atomic-energy and electronics activities—has as its most timely significance the hint that the Red Russians may well be where they were in the mid-1930's.

May Now Be Ready

With the development and production of the new-type weapons well under way, the Reds *may be ready to get going on new model army arms to replace the old models long in wide use.*

Compare the time intervals of the first and present arms programs. *The Reds' first rearmament program got going about 1930.* The new-type weapons the Reds needed in that era were pouring out by the time the Spanish Civil War began in 1936. There were the tanks: T-26 Vickers-type lights, BT Christie mediums, and T-28 Vickers-type heavies, which were "in the works" in 1931.

There were the all-metal high-performance aircraft: Polikarpov's Boeing-type I-16 fighter and the SB-2 Martin-type medium bomber.

There was the general automotive equipment: U.S.-type tractors from Stalingrad and Kharkov and Chelyabinsk and Kirov; Ford Model A cars and trucks from the Ford Cologne plant as transferred from Germany to Gorki in 1931; bigger cars and trucks from the Stalin plant in Moscow and from the one in Yaroslavl.

The Eighth Year

Then, in 1937, *about the eighth year after Red rearmament got under way*—the new models of army arms to replace the old stand-bys began to be standardized and went into production.

In 1936, the Simonov rifle was standardized to replace the manually operated M1891/30. Still other new-model rifles were introduced in the next few years, as well as new machine guns. In 1937-1939 came the present models of division and corps artillery pieces and new mortars.

This year—1953—is about the eighth year after the current Soviet rearmament program got under way. By the time-interval standards of the 1930's, it's "New Model Time"—time to replace old-model army weapons with the latest military styles in each particular conventional weapons category.

In point of fact, the Soviets—besides hitting the new and vital weapons categories with all they've got—have in the last few years been turning out several new weapons to fill certain relatively minor gaps in their army armament, just as they did in their 1927 arms program. In the Moscow May Day parade of 1951 they proudly unveiled a new "armored transporter." A weapons and personnel carrier for the armored forces had theretofore been a considerable Soviet Army deficiency for mobile warfare.

A superheavy AA gun has also been exhibited (clearly a result of America's plan to rely on the B-36), which now gives Russia a flak piece in the class of the German 1938 105-mm. and the later U.S. 120-mm.

New Vehicles

Motor transport (always a terribly critical deficiency) has been bolstered with new-type vehicles. Although a ZIS copy of the much-liked U.S. Studebaker 6-by-6 truck was rushed through toward the end of World War II, the full line of new trucks, while announced late in 1946, did not begin to appear in civil and military forms until 1949. That year was the year of the Soviet jeep, too.

The nature of this "new" motor transport (it's all copies of old U.S. models, the jeep actually being a Ford Model A) shouldn't lull Americans into thinking we haven't reason to worry about new Soviet Army arms when they do appear. There's no reason to think that recent Soviet achievements with electronics and planes and atomic energy don't bear on what the Soviets can do with army armament.

What can happen is well illustrated by the nasty surprise the Germans and the rest of the West got when Hitler invaded Russia in 1941. This surprise is well exemplified by a little green book

which German Army Intelligence published just six days before Germany attacked the Red Army. The book is titled "The Outstanding Tanks of the Soviet Union." It supposedly gives the "classified hot poop" so carefully collected by Admiral Canaris' notorious *Amt Abwehr* and other crack German G-2 agencies.

The book turned out to be grossly misnamed. It listed only the Reds' 1930 family of tanks. The main "mobile warfare" tank was given as the BT Christie of 13 tons with a 45-mm. gun; the main heavy, a 30-ton T-28 with a short 76.

When the Germans ran into the Reds' new tank family (the 32-ton T-34 with a long 76, and a 48-ton KV with a 76 or 152 (57 tons in the latter version), they shamefacedly had to issue paste-in addenda contrasting startlingly with the book's original data.

Guderian, one-time German Army Chief of Staff and the "father of Panzers," has written in his autobiography "Panzer Leader": "We believed that at the beginning of the new war (against Red Russia) we could reckon on our tanks being technically better than all known Russian types; we thought that this would more or less cancel out the Russians' vast numerical superiority...."

Superiority Lost

But he notes what happened when the T-34's really began to roll off Red production lines: "Numerous Russian T-34's went into action and inflicted heavy losses on German tanks. Up to this time we had enjoyed tank superiority, but from now on the situation was reversed. The prospect of rapid, decisive victories faded in consequence."

Guderian also reveals that the willfully blind Germans actually had had more than a hint that they didn't have "the world's best tanks," but missed their cue: "In the spring of 1941 Hitler had specifically ordered that a Russian military commission be shown over our tank schools and factories; in this order he insisted that nothing be kept from them. The Russian officers firmly refused to believe that the Panzer IV was in fact our heaviest tank. They said repeatedly that we must be hiding our newest models from them. . . ."

After repeated Russian protests, some Germans figured that the Russians must be way ahead of the Germans in tanks. But no good came of this accurate deduction.

Note how the Germans got into trouble: they compared their new tanks with those the Reds had long been known to have.

Invariably there are Americans who have no patience with conventional-type army weapons (whether of old or new model). They snort at such arms as relatively unimportant in view of radical new "wonder weapons." Such people consider worry about new Red army weapons therefore much ado about nothing.

The nasty surprise the Soviets gave the West in 1941 should stand as a lesson to people of that school, too. For the 1941 campaign revealed that, while developing and producing the then conventional-type weapons in their rearmament program of the 1930's, the Reds had also been at work on some very novel "secret wonder weapons."

These—Kostikov's rockets, for example—were actually ready for use during the first summer campaign. Indeed, the Reds not only used artillery-type rockets (as the Germans also did that summer), but ground-to-air and air-to-ground types.

In contrast, only the year before, our Office of Scientific Research and Development historians tell us, the U.S. Army and Air Force had failed to express interest in rockets, while the U.S. Navy told Dr. Vannevar Bush's defense scientists that the only sort of rocket it wanted was as an "assist" on an armor-piercing bomb.

"In short, we must get it into our heads that the arms situation, like business, is dynamic and ruthlessly competitive. To avoid weaknesses which may tempt aggressors to strike for an easy victory, Americans must realize that they have two businesses: their own and everybody's business of seeing that the Reds don't obtain decisive advantages over the West in quantity and quality of arms—and, for that matter, in the theory and practice of warfare."

These points cannot be overemphasized:

1. *That the "mad Russians" have fertile brains capable of far outstripping their engineers' and machinists' abilities to translate their ideas into solid materials which will perform according to the paper theory.* Thus by 1940 Soviet scientists were spelling out in unclassified publications their ideas about atomic energy and bomb making. But at that time such a project was quite out of the question.

2. *That the Soviets don't believe that new categories of weapons replace the old.* Their defense motto appears to be: "All the old and the new weapons, too." Thus before World War II they didn't make Hitler's terrible error and use aircraft as a substitute for field artillery. They built great quantities of both.

Fortunately, the Reds are far from supermen. They can fall down flatly on new-model arms. As a matter of fact, the new "armored transporter" was greeted with derision by Westerners. It is open-topped, hence offers no overhead protection against radar-fuzed air-bursting bombs and shells or against atomic weapons. Worse: it is not caterpillar-tracked.

It could then well be that the new family of Soviet tanks will not render ours obsolete. That we can hope. But the brutal fact is that we appear to have committed ourselves to the production of 13,000 tanks of around 50 tons (a Stalin heavy tank's weight) and to the expensive production lines to make them—before the Soviets have got going.

We clearly face the terrible risk that the Soviets will see what we're committed to in tank and antitank weapons and will then design and produce tank and other weapons intended to take our line of new Army hardware for everything it has—just as they devised armor for their KV which no German Army antitank gun could hole.

Should this be the case, we must be prepared to throw defense economy out the window. We must be ready to write off whole lines of military equipment—just as do commercial firms with goods that don't sell—and get on fast to a line of arms that will afford the security we need.

Ruthless Competition

In short, we must get it into our heads that the arms situation, like business, is dynamic and ruthlessly competitive. To avoid weaknesses which may tempt aggressors to strike for an easy victory, Americans must realize that they have two businesses: their own, and everybody's business of seeing that the Reds don't obtain decisive advantages over the West in quantity and quality of arms—and, for that matter, in the theory and practice of warfare. For in war as in business, theories and methods should change with conditions and the nature of the competition.

Portrait of a German General

British photo

Rommel's Papers Reveal a Great Tactician and Strategist

Hoffman Nickerson

THE recent book, "The Rommel Papers," is an important military document (Harcourt, Brace & Company, New York; 580 pages, $6.00). Indeed it has implications which go beyond the technical military sphere for it helps to remind us that all Germans, and especially all German officers, are not the nasty beasts too often pictured by the wartime propaganda put out by ourselves and our allies.

Chivalrous Opponent

The picture of Rommel as an honorable and chivalrous opponent is not stressed as it was in Brig. Desmond Young's "Rommel, the Desert Fox"; it is allowed to appear only incidentally and—as it were—indirectly, but it is unmistakably there.

The book was edited by B. H. Liddell Hart with the assistance of Rommel's son, Manfred; his wife, Lucie-Maria; and Gen. Fritz Bayerlein and was translated from the German by Paul Findlay. Most but not all of the text is composed of translations of Rommel's own war diaries, his written military appreciations, and his letters to his wife. He was an affectionate father and a devoted husband. Even when operations were at their hottest he wrote home incessantly, usually short notes which vividly illustrate his day-to-day impressions of the rush of events.

After brief introductions, the first eighty-seven pages are concerned with the future field marshal's part in the 1940 campaign in France. The greater part of the book tells the story of his operations in Africa. Manfred Rommel contributes two of the closing chapters, one of which connects up various notes by the elder Rommel on the latter's activities during the confused Italian events of 1943, while the other touches briefly on the brilliant commander's tragic last days, ending in his enforced suicide.

Mr. Nickerson is an outstanding military historian and author of numerous works including "Can We Limit War?" and "The Armed Horde."

Other Chapters

General Bayerlein, who was one of Rommel's chief subordinates in Africa and served for a time as chief of staff there and later as chief of staff of the army group which the Desert Fox commanded in France in 1944, has similarly compiled from Rommel's surviving notes and from his own sources brief chapters on the African winter campaign of 1941-1942 and on the fighting in Normandy in 1944.

The editorial comments and "fillers-in" of the narrative by Liddell Hart show the latter at his best. His style, as always, is lucid and lively. Moreover from time to time the reader is most grateful for an occasional pithy sentence showing how differently this or that African situation looked to the British commanders "on the other side of the hill."

Rommel was a professional soldier absorbed in his profession. In other words he was an individual of a type which has been violently abused by those who detest that sort of a man and warmly praised by those who admire disciplined courage.

He was not without interest in history and culture, for we find him using an interval of his scanty leisure to visit the remains of one of the Greco-Roman cities so admirably excavated by the Italians in their African province.

On the other hand, although he knew Hitler, he was indifferent to politics until his rise in rank put him in contact with the Führer and the leading National Socialists.

His case of conscience against Hitler —who after all had been legitimately elected Chief Magistrate of Germany— and his relation to the military conspiracy are not discussed here, perhaps because no new material has turned up since Brigadier Young wrote.

Given Africa Corps

The book is a study of generalship as exemplified by an able commander. In France in 1940, although only the commander of an armored division, Rommel played so brilliant a part that early in the following year he was given the proposed German Africa Corps, a small command composed at first of only two divisions but a command which was to prove largely independent.

Until the Anglo-American landings in French North Africa in November 1942, the few German troops south of the Mediterranean were largely neglected stepchildren of their high command. Hitler's headquarters thought of them as a side show.

On the other hand, their performance under Rommel was for a long time so brilliant that Germany rang with his name. During that period he and his subordinates were the only Germans in contact with the British. Accordingly, he was a logical choice in 1944 to command Army Group B in France, a position in which he was subordinate only to Von Rundstedt, the German commander in chief in the Western theater.

In Rommel's generalship, as in the careers of all able commanders, we find elements both new and old. Again and again his doings illustrate Clausewitz' famous saying: "The greatest quality of a general is firmness, and that is a gift from heaven." To firmness in all its forms—boldness, resolution, and persistence—Rommel added a clear, flexible mind, the power of rapid decision, and an astonishing energy.

In his middle twenties during World War I as a junior officer of infantry his dashing local successes showed the stuff that was in him.

In France in 1940 he saw that successful mechanized war demands that generals, at least up to the divisional level where he then was, should always be near their advanced elements and often in the front line.

The story of the fall of France in 1940 is familiar. Nevertheless it is well to be reminded that the aggregate number of tank battalions in the German armored divisions which dislocated the French Army and paralyzed the French high command was only thirty-six, whereas the French had no less than fifty-three tank battalions which they split up into little packets.

A Near Thing

The critical days of the whole campaign were May 13th and 14th. On the 13th, Rommel, in personal command of the advanced elements of his division, forced the first German crossing of the Meuse just north of Dinant. It was a near thing, for when he arrived he found his leading units badly shaken by the French fire.

Later in the day other crossings were made on his right and left. On the left near Sedan, three German armored divisions crossed during the afternoon of the 14th but their progress was delayed by French counterattacks.

Meanwhile Rommel with his single division had been the first to exploit success by pushing a small tank spearhead clear through the French front.

During the night of the 14th, so Liddell Hart tells us, General Corap who commanded the French troops between Sedan and Namur, alarmed by vastly exaggerated reports as to the number of Rommel's tanks which had penetrated his center and also by the threat to his right flank from the Sedan bridgehead, threw away any chance there may have been of successful resistance by ordering the abandonment of the line of the Meuse, most of which was still holding, and a retreat of some fifteen miles westward.

The speed of the German pursuit prevented the formation of another defensive front and permitted Guderian's race to the sea which produced the fatal Dunkerque pocket.

In the concluding phase of the cam-

"The impact that Rommel made on the world with the sword will be deepened by his power with the pen. No commander in history has written an account of his campaigns to match the vividness and value of Rommel's. . . .

"No other commander has provided such a graphic picture of his operations and method of command. No one else has so strikingly conveyed in writing the dynamism of blitzkrieg and the pace of Panzer forces. The sense of fast movement and quick decision is electrifyingly communicated in many of the passages— Rommel carries the reader along with him in his command vehicle. . . .

"Until I delved into Rommel's own papers I regarded him as a brilliant tactician and great fighting leader, but did not realize how deep a sense of strategy he had—or, at any rate, developed in reflection. It was a surprise to find that such a thruster had been so thoughtful, and that his audacity was so shrewdly calculated."—B. H. Liddell Hart in his introduction to "The Rommel Papers."

"In true judgment of performance, due account must be taken of the conditions and relative resources, together with the other factors that lie outside a commander's control. Only then can we properly estimate the quality of his performance. The outstanding feature of Rommel's numerous successes is that they were achieved with inferiority of resources and without any command of the air. No other generals on either side in World War II won battles under these handicaps, except for the early British leaders under Wavell. . . .

"For all his audacity and rapidity of movement and decision, Rommel comes out well, on balance, from the test embodied in Napoleon's saying that 'the greatest general is the one who makes the fewest mistakes.'"—B. H. Liddell Hart in his introduction to "The Rommel Papers."

paign Rommel's division was the first to break through the French front on the Somme and dash forward to the Seine, crowning its achievements by taking the coastal fortress of Cherbourg.

Two Phases

Rommel's African campaigns from mid-February 1941 to early March 1943 divide naturally into two phases, the first when he was facing eastward until November 8, 1942, the date of the Anglo-American landings in French North Africa.

This first phase included his first offensive which retook Cyrenaica, except for Tobruk, in April 1941, his repulse of the British offensive in June, his retreat from and reconquest of Cyrenaica about the turn of the year, finally his advance to El Alamein and the first few days of his retreat from that position.

The second phase, when he was threatened on two fronts, included his further retreat to Tunisia, his attempts to take the offensive there, and his departure from Africa in obedience to orders.

The African theater had a number of peculiarities. It was chiefly desert—even its fertile areas were deforested—and it contained only one town of any size, Tripoli. Accordingly, ground forces there could not hide themselves from air observation and air attack.

On the other hand it contained few obstacles to ground movement so that the fewness of its roads mattered little except during its rare period of torrential rain.

It was the only theater to which the Axis communications passed overseas and were therefore vulnerable to British naval action and also to air action based chiefly upon Egypt but also upon Malta.

British supplies, too, had to come by sea clear around the Cape of Good Hope, but the British had abundant shipping, and their convoys to Egypt could be molested by German submarines only in the Atlantic. All told, the British used to say that the North African desert was "a tactician's paradise but a quartermaster's hell."

Supply Difficulties

Again and again Rommel emphasizes the vital importance of supply and his difficulties in regard to it. On page 176 he rejoices in the arrival, shortly after mid-December 1941, of the first Axis convoy to reach him for more than a month, although that convoy was extremely small and nearly half of it had been sunk en route from Italy.

On page 180 we read that early in January 1942 the arrival in Tripoli of "a convoy . . . carrying 55 tanks and 20 armored cars, as well as antitank guns and supplies of all kinds . . . was as good as a victory in battle."

Pages 192 and 193 note the temporary improvement in his situation during the late spring of 1942 because of the heavy Axis air attacks upon Malta, but at the same time he laments that the British, even though forced to use the long Cape route, "were able to maintain supplies to the Near East on a scale far superior to our own." Fortunately for the reader the absurd term "Middle East" is not used.

At about the same time the future field marshal—he was as yet only a "Panzer general"—complains of the German Air Force's "rare" bombings of the British ports of departure in England and of the failure to execute the Axis plan for taking Malta.

On pages 244-245 he says that one reason for his early successes was the qualitative superiority of certain German weapons, probably tanks and antitank guns, over the more abundant British material and continues with an ironical comment on how well the Axis solved the problem of trans-Mediterranean transport, but only when it was already too late because of the Anglo-American occupation of most of French North Africa.

At this point he also notes his justified fear of American production—that avalanche of steel which was to do so much to crush the opponents of the Republic. When sick leave in Germany in October 1942 permitted him to survey the war as a whole, he returns to the subject of American industrial productivity (pages 296-297), correctly estimating that everything depended upon the outcome of the battle in the Atlantic against the submarines.

At this point American readers will note with amusement Liddell Hart's belief that the Desert Fox overestimates both American ingenuity and productivity in comparison with British, a contention which, however correct on particular points such as radar and later with regard to the artificial harbors in Normandy, might easily be pushed too far.

Material Superiority

Again, in analyzing his defeat at El Alamein Rommel attributes it wholly to the great British superiority in material when fighting on a narrow front which the geographical features forbade him to expand.

During his final retreat across Tripolitania he twice returns to the crippling effect of his gasoline shortage. During November 1942 most of the 500 tons which he had received had been flown over by the German Air Force while

"no less than 8,100 tons had been sunk by the British on the way." When writing to his wife on December 18, 1942, he says simply: "Without petrol there's nothing to be done."

Rommel and Air Power

In addition to his comments on the weakness of German trans-Mediterranean air transport, much might usefully be written in comment upon his estimate of the effectiveness of air power in general.

He says little about the disputed question as to whether it is worth while to bomb cities, noting only that after one of his retreats into Tripolitania the Italians objected to having the harbor town of Benghazi bombed on the ground that certain Italian senior officers owned houses there (!) and that in France in the spring of 1944 the Anglo-American Air Forces bombed "villages, bridges, and crossroads with complete disregard for the civilian population."

As to the African campaigns he writes that an "essential condition for an army to be able to stand in battle is parity or at least something approaching parity in the air," upon which Liddell Hart aptly comments:

"Rommel's conclusion here would seem to be brought in question by the successes which he achieved under conditions of air inferiority. At the same time the effect of the handicap becomes very clear in studying his account—the much increased demands on tactical skill and also the much increased risks."

Blamed Equipment

In his estimate of the Italians Rommel has little use for their high command but is far from contemptuous of their combatant formations. On occasions when these last made a poor showing he is careful to point out that much of the blame was due to their inferior equipment.

In general he considers the British command overcautious and the British conduct of mobile warfare defective because lacking in flexibility and too much given to issuing long cut-and-dried orders beforehand. On the other hand he praises the staunch fighting of the British units and the excellence of their training for position warfare in which operations could be thoroughly rehearsed in advance.

Wavell he considers a bold and skillful strategist far above all other British generals who served in the African theater. He also has high praise for Auchinleck's handling of the British retreat from Gazala to El Alamein and his organization of the defense of that position.

Throughout the book the reader is constantly reminded of the vast influence of the theater of war upon operations. After noting the striking differences between Rommel's campaigns in Mediterranean Africa and those in Northern France, one is tempted to wonder how he would have planned to meet a third variant of terrain and respective resources in, say, Korea.

Estimates Sound

In principle most of his strategic and tactical estimates were sound. As he truly said, the North African corridor leading to Egypt, and through Egypt to the military vacuum of the Near East with its precious oil supplies, was indeed worth much more to the Axis than Hitler and the German high command were willing to admit.

Again, when the British with their ultraconservative but resolute generalship fell back to the short El Alamein front which the sea and the soft sand of the Quattara Depression forbade him to turn, he saw clearly that his best chance was to attack at once before his army was ground down by increasing British superiority in material.

Once more, in Northern France in the early months of 1944 he, the great apostle of mobility, was right in wishing to have the German armored divisions intended for the counterattack placed near the coast so that they could intervene promptly before the Anglo-American invaders had consolidated a bridgehead sufficiently large to serve as a springboard for enough of their human and material resources to produce a second El Alamein.

No other German field marshal had faced the British since 1940, and consequently none of them appreciated how seriously the Anglo-American Air Forces, operating in a theater like Northern France, could interfere with movement behind the German coastal front.

High Tragedy

Finally, the book has an element of high tragedy. Rommel's campaigning is intertwined with the story of his relations with Hitler, that strange man whose touch of genius was presently submerged under his megalomania and criminal lunacy.

The plot is as regular as that of Oedipus or Macbeth. At first Rommel admired Hitler and in June 1940 was especially favored by him. As time went by, however, the straightforward soldier began more and more to question the wisdom of the Führer's conduct of the war.

Next he saw that all the leading National Socialists were not thinking of Germany's good but were indifferent to the ruin which they were bringing upon their country if only they could prolong their own lives a little. Yet for some time he still felt himself bound by his military oath.

After a long struggle with his conscience—of which General Bayerlein and Manfred Rommel tell us only that he did not know and would not have approved of the plot to kill Hitler—he joined in the conspiracy against the Führer, at least to the extent of approving a plan to try to spare Germany a Russian invasion by a separate peace or a surrender in the West.

This of course was enough to compromise him. A few days before the unsuccessful attempt on Hitler's life, on June 17, 1944, Rommel was severely injured in a motor accident caused by an American or English plane. While convalescent at his home in Germany, Nazi agents of the Führer offered him only the choice between enforced suicide to be officially announced as a heart attack or, on the other hand, arrest, torture, then a public trial and execution as a traitor, together with harsh action against his family.

We are shown a photograph of the huge wreath of flowers which Hitler sent to adorn the official funeral after the field marshal had killed himself.

Advisory staff

The National Security Council

It Advises the President Regarding Integration of Policies for Defense

The Council assesses the objectives, commitments, and risks of the United States in relation to our actual and potential military power and resources

THE statutory function of the National Security Council is to advise the President with respect to the integration of domestic, foreign, and military policies relating to the national security so as to enable the military services and other departments and agencies of the Government to coöperate more effectively in matters involving the national security.

Appraises Objectives

Subject to direction by the President, it is the responsibility of the Council to assess and appraise the objectives, commitments, and risks of the United States in relation to our actual and potential military power, to consider policies on matters of common interest to the departments and agencies of the Government concerned with national security, and to make such recommendations and such other reports to the President as it deems appropriate or as the President may require.

Section 10(a)(3) of the Atomic Energy Act, as amended by the Eighty-second Congress (Public Law 235) provides that the Atomic Energy Commission may, under certain conditions, enter into "specific arrangements involving the communication to another nation of restricted data on refining, purification, and subsequent treatment of source material; reactor development; production of fissionable material; and research and development relating to the foregoing," provided that the President, after securing the recommendation of the National Security Council, makes certain determinations in writing incorporating the Council's recommendation.

Council Members

According to statutory provisions the Council is composed of the President, the Vice-President, the Secretary of State, the Secretary of Defense, the Director for Mutual Security, and the Chairman of the National Security Resources Board.

Secretaries and Under Secretaries of other executive departments and of the military departments, the Chairman of the Munitions Board, and the Chairman of the Research and Development Board may be appointed to the Council by the President by and with the advice and consent of the Senate, to serve at his pleasure.

By law, the Joint Chiefs of Staff are the principal, military advisers to the National Security Council. In addition, the Central Intelligence Agency is, by law, under the direction of the National Security Council and is the intelligence adviser to the Council. The statute also provides that the Council shall have a staff headed by a civilian Executive Secretary appointed by the President, with such other personnel as may be authorized by the Council.

Scope

The concept of the National Security Council is that of an advisory staff for the President on all major policies affecting the national security. Accordingly, the Council performs its functions of advising the President by submitting for his consideration policy recommendations representing an integrated assessment and appraisal of our over-all objectives, commitments, and risks in the light of our military and other capabilities.

These recommendations represent the coördination of the various points of view of all appropriate executive departments and agencies.

The Council's work is accordingly governed by the following basic concepts:

1. The NSC deals only with issues affecting the national security;
2. The Council is advisory; by advice and recommendations to the President it helps him to resolve the executive will, performing whatever functions he thinks would be most helpful to him in this respect;
3. The NSC seeks to integrate domestic, foreign, and military policies so as to enable Government agencies to coöperate more effectively in national-security matters;
4. It acts, according to Presidential direction, to coördinate more effectively policies and functions of Government agencies relating to the national security;
5. The Council is concerned with both our actual and our potential military power;

6. The NSC is not limited to areas of agency agreement—on its own initiative, NSC may seek out areas of agency conflict or omission to act, so as to present alternative or new courses of action for executive decision.

The Psychological Strategy Board reports to the National Security Council on its activities and on its evaluation of the national psychological operations, including implementation of approved objectives, policies, and programs by the departments and agencies concerned.

Under the NSC the Interdepartmental Intelligence Conference is responsible for the coördination of the investigation of all domestic espionage, counterespionage, sabotage, subversion, and other related intelligence matters affecting internal security.

Internal Security

Also under the NSC, the Interdepartmental Committee on Internal Security is responsible for coördinating all phases of the internal-security field other than the functions under the purview of the IIC.

On March 17, 1953, the President approved the following recommendations for strengthening the National Security Council:

In order to make possible a genuine exchange of ideas and foster free discussion it is planned, as a general rule, not to have more than eight persons who have the right formally to participate as Council members. This number includes statutory members and standing-request and *ad hoc* participant members but does not include advisers, observers, the Special Assistant to the President for National Security Affairs, or NSC staff members.

Statutory Members

Statutory or standing-request members include: The President (*Chairman*), the Vice-President, the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Director for Mutual Security, and the Director of Defense Mobilization. It is proposed to transfer the Council membership of the Chairman of the National Security Resources Board (which Board is to be merged into ODM) to the Director of Defense Mobilization.

Participant members.—In addition to the above members, the President invites such other officials of the Government to attend as participant members as his convenience and the agenda items at a particular meeting make desirable. Such invitations are either on standing-request or *ad hoc* basis. A standing-request participant member attends all meetings until the President otherwise decides. An *ad hoc* participant member attends only such meeting or part of a meeting as he is specifically invited to attend.

Others Who Attend

Advisers, Observers, Staff.—In addition to statutory and participant members, there are in attendance at each Council meeting the following persons who do not formally participate as Council members: (1) *Advisers*—The Chairman of the Joint Chiefs of Staff, the Director of Central Intelligence, and the Special Assistant to the President for Cold War Planning; (2) *Observers*—Such person or persons as the President desires to attend for the purpose of observing, but not participating; (3) *Staff*—The Special Assistant to the President for National Security Affairs, the Executive Secretary and the Deputy Executive Secretary of the NSC.

The National Security Council was established pursuant to Public Law 253, Title I, Section 101, Eightieth Congress, approved July 26, 1947, as amended by Section 3 of Public Law 216, Eighty-first Congress, approved August 10, 1949, and by Section 501 (e) of Public Law 165, Eighty-second Congress, approved October 10, 1951. By Reorganization Plan No. 4, effective August 20, 1949, the Council was transferred to the Executive Office of the President.

When General Eisenhower became President of the United States the National Security Council assumed new and greater stature. That it would be so was indicated when the President devoted one of his major preëlection addresses to the Council, its organization and utilization, as an essential element in the determination of national strategy.

Since General Eisenhower has assumed the Presidency he has used the Council constantly as the over-all strategic arm of our national Government. In so doing our foreign and military policies are brought into close cohesion and through the Council are afforded that degree of fluidity which is so essential to successful national security.

The National Security Council thus becomes a basic vehicle in adjusting national strategy—both military and economic—with the foreign and domestic needs of our country. The accompanying article is well worthy of analysis in the light of the important rôle now being filled by the Council.
—The Editors.

Civilian Consultants

In order to bring to the Council deliberations a fresh, frequently changing civilian point of view and to gain public understanding of national-security problems through the use of civilians of stature, from time to time the President may appoint on an *ad hoc* basis one or more civilian consultants or small civilian committees as informal advisers.

As a general rule, a civilian consultant does not formally participate in a Council meeting and a civilian committee appears at a Council meeting only when its report is presented.

The Special Assistant to the President for National Security Affairs is the principal executive officer of the National Security Council.

The Planning Board

The Planning Board is the principal body for formulation and transmission of policy recommendations to the Council and, in carrying out this responsibility, performs the following functions:

1. It anticipates and identifies problems and situations affecting the security objectives, commitments, and risks of the United States and initiates action to provide the required analyses and draft policy statments for the consideration of the Council.

2. It facilitates the formulation of policies during the process of drafting policy recommendations by marshaling the resources of the respective departments and agencies, by identifying the possible alternatives, by endeavoring to achieve acceptable agreements, by discussing differences, by avoiding undesirable compromises which conceal or gloss over real differences, and by reducing differences to as clearly defined and narrow an area as possible prior to reference to the Council.

Cold Extrusion of Steel

New Metalworking Techniques Speed Up Ordnance Production

William J. Meinel

President, Heintz Manufacturing Company

THE interest-catching phrase "cold extrusion of steel" from its entry into American usage in 1946 has given rise to a variety of conceptions of its meaning and great discussion among varying points of view.

Here is the dramatic story of the transfer to this country of the European work on cold extrusion of steel, American advances in this and allied techniques, and the application of these labor- and material-saving processes to ammunition components. It is told by William J. Meinel through whom Army Ordnance acquired the know-how and its first cold-extruded parts.

Mr. Meinel, public-spirited president and chairman of the board of Heintz Manufacturing Company, Philadelphia, also serves as chairman of the board of the Federal Reserve Bank of Philadelphia, trustee of the University of Pennsylvania, and director of a number of industrial concerns.

Wartime recipient of the Naval Ordnance Development Award as well as a citation from Army Ordnance, he was awarded the 1947 Jones Gold Medal by the Philadelphia Post of the American Ordnance Association. He has also served as president of the Post.

The editors propose to publish articles in subsequent issues describing the techniques and processes used by other leading industrial organizations specializing in cold extrusion.

Brought from Europe

Early that year a score of varieties of hollow cylindrical steel shapes brought from Europe via Philadelphia were laid on the Pentagon desk of Maj. Gen. G. M. Barnes, then Chief of the Research and Development Division, Office of the Chief of Ordnance. They included minor-caliber projectiles, cartridge cases for small arms and artillery, and miscellaneous pieces.

The shapes were not unusual, but from the method of their manufacture disclosed by the accompanying painstakingly accumulated mass of German drawings of tools and operations, patent copies, and interviews with workmen, we were able to paint a picture—not of just another development born of wartime exigencies but of potentially very great saving to the Government in raw material, machines, and man-hours.

Directive Given

Immediately, out of the suggested table of steps presented to that meeting of Ordnance officers with Army, Navy, and civilian representatives of JIOA, personnel of the Department of Commerce, and of Heintz Manufacturing Company, came the directive to Heintz to accumulate and translate the data, prepare it for publication, and then see if it would work—try it out in metal.

Results? In a few months Ordnance had a 156-page report of which 80 pages were of drawings—all in English—and later another report of more than 250 pages. The Ordnance Research and Development staff also had on hand for examination and proof that it not only could be done in America but could be done better, their first cold-extruded standard 20-mm. high-explosive shell bodies and burster tubes.

The next step was a triple-phase, modest-sized program of (1) research in the metallurgy of cold extrusion to see which steel formulations would extrude and with what effort and effect on them; (2) research in the chemistry of the lubrication system essential to extruding; and (3) manufacture of two more ambitious-sized ammunition components of new design and also of higher strength than usual.

Four more volumes of reports went to the Army, and again the Army, in turn, released those on metallurgy and chemistry to American industry through the files of the Department of Commerce and the Library of Congress.

Greater Strength

The other two volumes told of the failures and final success in making the small lots of the new rocket-motor bodies and new 75-mm. shells. Solely by the cold-forming of these bodies out of steel containing less than a heat-treatable quantity of carbon came strength characteristics far higher than in such bodies when made conventionally; that is, by extensive machining of hot forgings of high-carbon steel followed by heat treating.

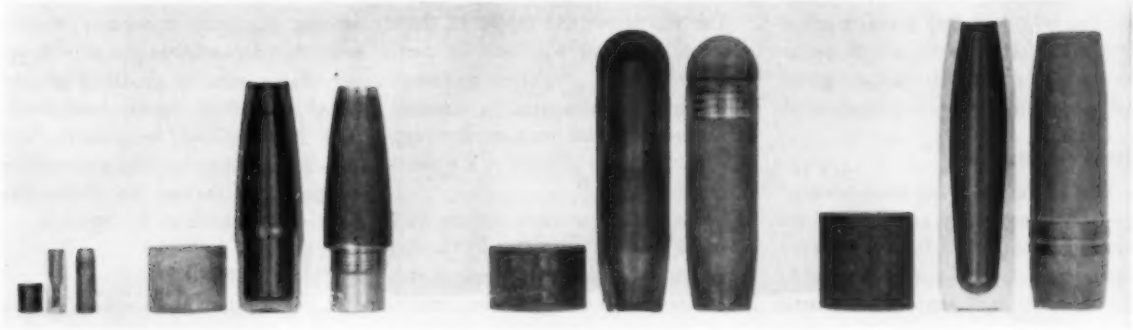
Our critique about that time listed results and indications amply justifying further steps (incidentally, forcing from me the admission that they justified the expenditure we had made of more than twice the sum received from Ordnance).

Some Conclusions

Here are some of the conclusions:

1. For the first time—anywhere—a high-explosive cannon shell as big as 75-mm. had been made by cold-press methods! That fact was further confirmed during our quest in Europe for presses for continued research. Presses heavy enough for such work, let alone for the bigger operations even then in the planning stage, had not existed there.

2. While at room temperature, steel of carbon and alloy content within limits could be made to flow into sym-



All the ammunition components shown on this and the following page were made from low-carbon steel bar stock by the cold-extrusion method. For each component the starting, sectional, and finished piece is shown and the billet and finished-piece weights given. Above, left to right, are the 20-mm. shell body (0.25 lbs.; 0.234 lbs.), rocket head (5.75 lbs.; 4.3 lbs.), 75-mm. shell (9.22 lbs.; 8.9 lbs.), 76-mm. shell (12.23 lbs.; 11.39 lbs.). Other similar examples are shown below.

metrical shapes by the use of pressures up to many times the yield strength of the metal in the annealed state.

Lubricant System

3. The practical means of cold-working steel where plastic deformation takes place beyond a minor degree is in the use of the lubricant system of a properly applied metal phosphate acting as "host" to a lubricant.

4. With such a lubricant as may not be wiped off even by multiple applications of working pressures of more than 200 tons per square inch, the friction between tools and work metal may be reduced to a minimum, permitting steel under such pressures to flow plastically, almost as if it were molten, past tool surfaces and remain sound and structurally solid. This is true even when reductions in cross section of more than eighty-five per cent are made in one stroke.

5. Without such a lubricant, this work is not feasible.

6. Tool failures had forced radical changes and improvements in tools to withstand high pressures, and, subsequently, still better design and maintenance of punches and tool holders had to keep step with higher and higher work loads.

Large Reduction

7. Deep-drawing operations of the conventional type, *i.e.*, where reductions in cross-sectional area are limited ordinarily to a minor amount, could be done to more than fifty-five per cent reduction at a time—a heavy ironing operation, indeed.

8. Two or more drawing operations could be replaced by a single extrusion operation.

9. A backward extrusion operation, even though requiring more than 150 tons per square inch, properly done — with due concentricity established and metal caused to flow, not rupture—presented substantial and positive advantages over a "hot-pierced" or "hot-upset" piece.

10. While "warming" different steels to varying degrees reduced work loads measurably, economic factors including effects on tool life, lubricants, handling, and other equipment, and on labor might not favor that expedient.

11. The enhancing of strength in steel by cold-working to the extremes now made possible and practical (up to triple its annealed yield strength) could dictate the use of mild steel, eliminate heat-treating for strength, and thereby save in critical alloy consumption in selected instances.

12. The most favorable employment of heavy cold-forming results when the designers of cylindrical bodies, solid or tubular, become familiar with these great advances in this method of manufacture—its limitations and advantages —and keep them in mind when designing for production.

13. Mechanical presses are indicated as desirable from the standpoint of continuous motion through the point of contact with the work, along with their speed and lower maintenance under rigorous operating conditions. Hydraulic presses seem to have a more nearly ideal cycle but, except in the very largest sizes, do not appear to be economical.

Spectacular Operation

"Extrude steel cold?" That sounds spectacular—and it is. But extruding is

The two artillery shells below had the following billet and finished-piece weights: left, 120-mm. (43.3 lbs.; 42.13 lbs.); right, 155-mm. (78 lbs.; 76.25 lbs.).

not the only cold steel pressing operation benefiting from the use of the lubricant-tooling-press technique which makes extruding possible and practical.

Picture Beclouded

Talk of "the cold-extrusion process," by that or any other name, may have beclouded the picture. It probably is not descriptive of this new technique of making finished ammunition metal components. If knowledgeably used, it indicates that one or more extrusion operations of one kind or another were used along with other types of cold operations. It does not indicate the advances in the steel press operations of sizing, coining, piercing, drawing, deep drawing, ironing, nosing, necking, heading, etc., now brought about.

When that first experimentally made "research" 75-mm. shell was exhibited to the production branch of Ordnance, the data on the technique and the task of using it in producing the 105-mm. shell body, cold, were passed on to a facility having some production equipment and past experience in shell making. Large quantities have been produced there and officially termed "good shell."

To make a large steel cartridge case from bar stock, likewise never done anywhere in the world, was the next challenge to us. It meant making a case better than brass cases and from mild-steel bars which would use half or less of the ingot weight consumed in cartridge cases drawn from disks sheared from steel plates.

The acceptance test report on those cases delivered in 1949 said in part: "The steel cases . . . showed improved functioning as compared to standard brass cases . . . are considered acceptable . . . and are suitable as a replacement component."

These cases were made with no final thermal treatment. Fired under varying conditions of pressure, temperature, etc., from time to time up to the present, none of them has failed.

Other shell bodies up to 155 mm., rocket motors and heads, and miscellaneous components made from Heintz-designed operations, tools, lubricant method, and using Heintz-trained personnel have followed in experimental and production quantities from more than one facility.

Skills Not Critical

It has been demonstrated that the method may be transplanted to other organizations—that skills and controls need not be considered as very critical. Search of patent literature discloses no bar to practice of the art.

Conclusive determination of comparative cost could come only when the life of tools was demonstrated. Production runs alone would answer that question.

European experience on their hard jobs considered tool life good at 10,000 to 20,000 press strokes.

Here is late news! On a single backward extrusion operation of greater severity from the standpoint of tool wear than any other in our experience, one of our punches produced 289,433 pieces of a Navy rocket head body. The Navy should be pleased. The punch, when it broke from unavoidable fatigue, still showed no measurable wear. Longer life may be expected.

What Kind of Steel?

Regarding the steel question, which has caused more discussion than any other phase of cold extrusion, what kind is needed?

Low-carbon, hot-rolled, round bar stock, fully killed, of fine grain and sound surface, with a minimum of non-ductile chemical constituents is satisfactory for most items in all the experience we know about. The lower the carbon and alloy content, the lower the loads in the tools. The more nearly unbroken the surface, the smaller the opportunity for stresses to localize and give trouble.

If desirable, round-cornered square bars can be accommodated in certain production and pilot tools now using round bar billets.

In the early days it seemed that deep-drawing auto-body stock, except in bar form instead of sheet, was desirable. Our steel suppliers worked with us beautifully. Like every one, though, including our own press-shop people on conventional work, they said, "The things you fellows are doing to steel look really cruel," and the impression got around that only highly selected steel is usable.

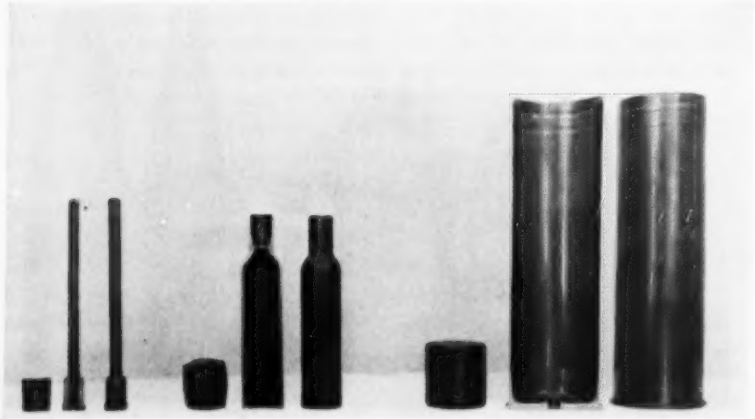
Specification Drafted

A military specification was drafted, based mostly on conventional experience, then revised by a rider on most items allowing changes "subject to negotiation between purchaser and supplier."

As of now, we understand the specification imposes no limitation on our suppliers and in general is regarded as "for information only."

When we've run into trouble, we have been as quick as anybody in blaming it on steel. Sometimes we've been wrong. Maybe a good many times it was our fault. We've tried to adjust our work, though, to the realities of steel

Below is the burster tube (0.622 lbs.; 0.625 lbs.), rocket motor (2.22 lbs.; 1.90 lbs.), and the 105-mm. cartridge case (6.09 lbs.; 5.40 lbs.).



supply, including mill practice and mill economies. Limitations set forth in specifications drafts may affect some mills, but we can't say they are needed for our practice.

For example, it has just not been proved in our case exactly how much of metallic incidentals we can live with. They have not been a major problem for us yet—and our mill friends may say that's because they have made a real effort to keep them low.

As to nonmetallics, the same is true. The measure of what we can stand seems to be the ductility of the metal.

Merits Support

If there's value to industry and national welfare in the use of cold shaping—as we think there is—mills and fabricators will coöperate. It needs and merits the support of steel producers.

The degree of development in tooling, lubricants, and press-operating techniques may or may not have been matched by the steel producers in raw material to meet the special requirements of the press operations.

In the steel auto-body business, the mills were faced with a somewhat similar new use—a new fabricating technique which demanded coöperative effort and adjustment of their practice. It took time and effort.

In Europe, when heavy cold-working of low-carbon steel came up with such great economies, the mills didn't have the ideal product ready. It took quite a while for a government-appointed coordinator to integrate the effort and bring about adjustments on the part of all factors and to arrive at commonsense compromises which really integrated procedures.

We echo the words of a good steel friend of ours—"Not enough production experience has been had yet either by extruders or the mills to establish a firm specification."

May Face Shortage

We have been repeating for years that the awful shortage of metals which faced Germany may well face us one of these days. And it *will* face us in the event of another great war. The economies in metal by using cold-forming methods will really save lives then.

"With such a lubricant as may not be wiped off even by multiple applications of working pressures of more than 200 tons per square inch, the friction between the tools and work metal may be reduced to a minimum, permitting steel under such pressures to flow plastically, almost as if it were molten, past tool surfaces and remain sound and structurally solid. This is true even when reductions in cross section of more than eighty-five per cent are made in one stroke. Without such a lubricant, this work is not feasible."

On the subject of raw material, trade papers comment on the possibility of a shortage in bar stock. In meetings last year where it was pointed out to the steel industry quite officially that "cold-formed" projectiles are "better and cheaper," it also developed that specifications for the required bar-stock steel are not in total more exacting than for conventional shell steel and that up to certain diameter extensive mill capacity still exists.

Since the adequacy, or rather the inadequacy, of our raw-material resources now at long last is being given serious attention, the means to get out of a unit of steel two shells or two cartridge cases or two fire-extinguisher bottles or over three spark plugs instead of one seems quite timely.

"In 1950 we were taking from the earth (among other things) 3½ times more iron ore than in 1900. . . . The quantity of most metals and minerals used in the United States since the First World War exceeds the total used throughout the entire world in all history preceding 1914.

"This vast drain upon resources that cannot be renewed, greater today than yesterday, and inescapably greater tomorrow than today, has become the most challenging aspect of our present-day economy. A ton of ore removed from the earth is a ton gone forever.

"The time has clearly passed when we can afford the luxury of viewing our resources as unlimited and hence taking them for granted. In the United States the supplies of the evident, the cheap, the accessible, are running out. The plain fact is that we skimmed the cream of our resources, as we now understand them; the pause must not be too long before our understanding catches up with our needs."

The foregoing quotations are from the recent report of the President's Materials Policy Commission informally known as the Paley Commission.

Interesting Applications

Spectacular metal saving, however, is not the sole value of this system of surface treatment or lubrication, tooling design, and heavy-press operation. There are applications interesting to a great degree in many other types of press, drawbench, and header operations.

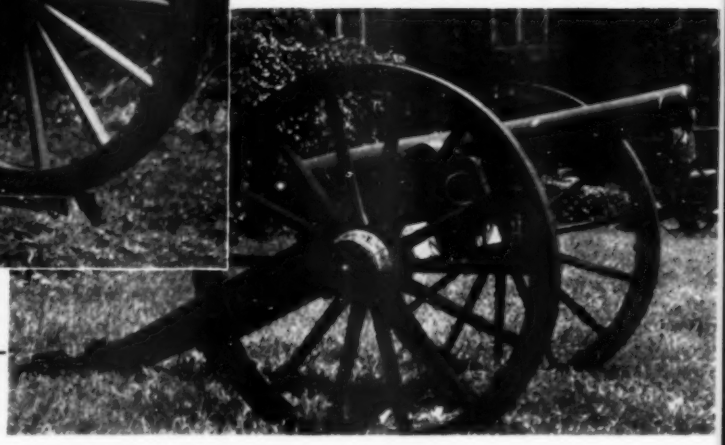
"There is no mystery about it," was the recent remark of an old-time successful manufacturer of 81-mm. mortar shells now in large-quantity production of the same shell using the new technique of Heintz origin, "and we can use the same steel for cold-extrusion as we use for conventional methods."

A production facility of more than twenty-five presses and complementary processing, handling, and finishing equipment has been set up in a specially constructed space. Representing a fixed investment in excess of $7,000,000, it will be available permanently for Naval Ordnance and for commercial work. It will furnish millions of extrusion press strokes for production as well as experiment and development.

Source of Knowledge

Manned by engineers and technicians, some with experience predating the art in this country, most with up to eight years of living with the project here, this organization and plant are expected to serve this country's industry as a continuing major source of knowledge on press operations in the interest of progress and economy.

Confidence in the value of these developments backed by much, much, hard work and other resources expended steadily since the last war has produced a great body of technical progress for America.



Above, 12-pounder light field gun, U. S. model 1857. At right, a 3-inch Rodman field rifle called the Napoleon.

Bedford Forrest

Tactical Teamwork Was His Secret Weapon

Jac Weller

CONFEDERATE generals who served in the Western armies are not so well known as those commanded by General Lee in Virginia. The name Forrest brings to the minds of many only a gigantic man with bloody sword and blazing eyes mounted on a tremendous horse leading one of his furious cavalry charges. Not that he doesn't deserve to be so remembered; he does. Not since Richard Plantagenet of the Lion Heart has any army commander possessed such great physical strength and personal combat efficiency.

Killed Thirty Men

Richard did his fighting encased in what amounted to the twelfth-century equivalent of a light tank. Unprotected by armor, Forrest killed or maimed in hand-to-hand encounters during the four years of war at least thirty opponents. In the waning days of the Confederacy, as a lieutenant general, he fought six Union troopers singlehanded and came away under his own power.

Supply Genius

History has emphasized Forrest's unique campaign strategy and revolutionary battlefield tactics. Yet his victories were fully as much the result of his lesser-known genius for the use and supply of weapons. The colorfulness of the man himself and his fantastic accomplishments with cavalry tend to obscure his contributions to arms and their use as a team.

Forrest accomplished a great deal; his innate worth as a commander is high. His Murfreesboro raid and operations in East Tennessee in the summer of 1862 contributed much to make possible Bragg's Kentucky campaign. The West Tennessee invasion in December of the same year helped to defeat Grant's second Vicksburg campaign.

Forrest's use of his cavalry on foot in battle was studied by the professional soldiers of Europe before it was appreciated here. The British Field Marshals, Viscount Wolseley and Sir Douglas Haig, as well as the Imperial Russian General Staff, knew more of Forrest than most American officers did during World War I.

The Forrest Legend

His men rode incredible distances mounted, dismounted, and then fought superbly on foot. He took fortifications with cannon made of logs and wagon wheels. He captured gunboats. In epic style he pursued, fought, and captured all 1,700 of Streight's raiders with less than 600 men of his own. The Forrest legend started as far back as 1862. His sobriquet, "The Wizard of the Saddle,"

tended to conceal even then his basic all-arms ability. Too long the authorities at Richmond thought of him as a cavalry raider only.

There was really little of the raid in most of his campaigns. When Forrest went into what had been enemy territory, he went in to use every resource of the community. If forced out, he brought out all that was movable and of value. He and his troopers fought as infantry for three days at Chickamauga.

Complete Victory

In the Battle of Brice's Crossroads, with a numerical inferiority of two to one, Forrest won one of the most complete victories of the war over beautifully armed and equipped Federal infantry, artillery, and cavalry.

He was a good battlefield commander. He was also what is far rarer —a master of practical military administration and logistics. Forrest's military thinking, particularly about weapons, was as unusual as the man himself. His basic soundness made his strategy and tactics possible. To us today a study of horse-mounted troops may seem antiquated, but the handling of mechanized troops is very similar. As long as soldiers have to be armed and have to fight as a weapons team, Forrest will be rewarding to the professional student. In order to understand the soldier one must know the man.

Forrest didn't become a soldier until a few days before he was forty. He enlisted as a private five days after Tennessee seceded. Few men have taken so much know-how with them into any army. He was born in the wilderness and, at sixteen, took his father's place as head of a large family. They weren't plantation aristocracy; he had three months' schooling in his life.

Within a few years Forrest made a lot of money as well as a name for fearlessness and business ability. By 1860, he had great relative purchasing power, perhaps more than any one today after taxes. After volunteering, he was appointed a lieutenant colonel and asked to raise his own battalion.

His first problem was to raise men; his second to organize, arm, and equip them. His private wealth which he used unstintingly in the public cause helped. His experience and his knowledge were even more important. His staff was composed of men used to working for and with him as civilians. They did a first-rate job, but Forrest behaved in the army as he had in supervising his own enterprises.

He inspected personally and frequently every single soldier, horse, and item of equipment in his whole command even when he had divisions under him.

According to one of his veterans, he recalled details of individual soldiers and their equipment after months of active service. The "on-the-toes feeling" that every officer wishes to instill in his command was intensified by Forrest's civilian experience before the war.

Meticulous Planning

Organization came naturally to Forrest, but it was always based on personal planning. He could and did extemporize brilliantly but much that some thought good luck was the result of personal planning weeks before. His powerful mind dispensed with lists and charts, yet his staff testifies to a tremendous power of concentration for hours at a time. After crossing the Tennessee at Clifton on the first invasion of West Tennessee the army was virtually without percussion caps. A civilian brought in tens of thousands purchased in Memphis at Forrest's request and with his private funds days before.

In the second West Tennessee invasion the Confederate forces found a civilian population awaiting their arrival with supplies gathered and volunteers already partially organized. Forrest had sent along Col. Tyree Bell, an able officer well known politically in this section, to prepare the way.

In the field of weapons, Forrest made his greatest contribution. Nowhere was his previous personal life more important to him than in connection with arms. He was a product of the wilderness and the frontier. Before he came of age, he had fought four men in the public square at Hernando, Miss. Three fell by his pistol and knife. The fourth saved himself by flight.

He was an acknowledged expert with revolver and rifle long before the war. At Donaldson in his first serious combat, a Union sharpshooter was annoying his regiment from the top of a tall tree at long range. Forrest took a Maynard rifle from one of his men and with one shot brought the enemy soldier headlong to the ground.

Forrest's opinion of sidearms was far from orthodox, although by the end of the war even the Union cavalry came around to something of the same idea. When he was raising his first battalion in Tennessee and Kentucky in the summer of 1861, he bought with his own funds a great deal of arms and equipment, including 500 Colt Navy revolvers.

He had no respect at all for sabers. They were not only foreign to the frontier fighting that he knew well but also likely to be used in the frenzy of combat in a way that, in the hand of a man of ordinary strength, would not inflict serious wounds.

Great Strength

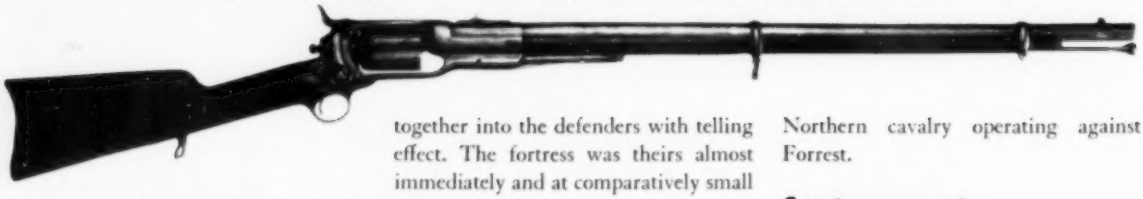
Forrest himself carried a saber ground to a razor edge, but he didn't believe in it for his men. His own personal strength was such that on one occasion he practically severed a powerful Union officer's head from his shoulders with a single blow. Even a pocket knife or an ax were fatal weapons in his hands, but for his soldiers he preferred revolvers.

As regards shoulder weapons, Forrest's ideas changed somewhat during the war. Because of difficulty of obtaining rifles or carbines, his first regiment was armed in large part with sawed-off, double-barreled shotguns. These were extremely effective in his charge of Sherman's pursuing column after Shiloh. The regiment paused at 25-yard range, emptied their shotguns, and then went on in with revolvers.

Mr. Weller is a well-known authority on ordnance of the American Civil War.

So employed, buckshot can be extremely effective; however, in general, Bedford Forrest liked to fight dismounted and at longer range. Nothing is so typical of Forrest as the use of rifles, particularly long-range rifles.

The Colt revolving rifle was issued to the Union cavalry operating against Forrest.



They saved the lives of his men by keeping the enemy cavalry too far away to be dangerous with their quicker-firing but shorter-ranged carbines.

Preferred Sharps

At first he had a preference for Sharps' breechloading weapons. Later on, however, because of the scarcity of these and also because of their poor obturation and combat accuracy, Forrest tried to arm every single trooper with a short Enfield rifle. The long infantry rifle had a barrel too clumsy to carry on horseback; the standard carbine was too short to be effective dismounted.

However, between these two extremes there were several models of the British Enfield that were almost perfect for Forrest's purposes. Even today the short musketoon Enfield will shoot remarkably well on individual targets up to a full 400 yards.

Every trooper normally had a rifle with which he was capable of full infantry performance dismounted. The most skillful had the most accurate weapons and were designated as sharpshooters. These Forrest used in every protracted engagement throughout the war.

Perhaps the most dramatic employment of them was in the capture of Fort Pillow on the Mississippi. The sharpshooters picked off at long range most of the Union officers and thereby gained a bulge, as Forrest called it. They then slowly advanced under cover until they were within 150 yards of the fort.

They concentrated a covering fire of such volume and accuracy on any Union soldier showing himself that the assaulting lines of Confederates walked forward carefully, crossed the ditch, mounted the earthwork to just beneath the parapet without firing a shot or suffering casualties. At a word of command, the Confederates rose and fired together into the defenders with telling effect. The fortress was theirs almost immediately and at comparatively small cost.

An indication of the real usefulness of the different Confederate cavalry commanders is given by the arms they chose for their troopers. Jeb Stuart in Virginia, a true master of reconnaissance and mounted fighting in the classic cavalry style, preferred the saber.

John Morgan, the raider nonpareil, wanted each of his soldiers to have four, six, or even more revolvers for use on horseback. Even discounting the supply and maintenance problem in connection with Morgan's idea, which was certainly insuperable for any large body of men in the Confederacy, revolver fire on horseback gives a maximum effective range of about twenty-five yards which would certainly have been insufficient for any field operations.

Not Merely Cavalry

Actually, Forrest's men were not merely cavalry; they were soldiers and did anything and everything that soldiers of any kind could do. Forrest realized that for serious fighting a man on foot armed with a Minié rifle was immeasurably superior to any horseman. Even though Braxton Bragg and for a long time the authorities in Richmond considered Forrest as a cavalry raider only, the Union commanders knew better.

A rare compliment was paid Forrest and his men by Union General William Sooy Smith who complained that Forrest's muzzle-loading Enfield and Austrian rifles put the Union troopers armed with the very best breechloading and repeating carbines at a disadvantage. An interesting development of this same thinking was the issue of the Colt revolving rifle, discarded early in the war for use by the infantry, to Northern cavalry operating against Forrest.

Counterarmament

An even more astonishing counterarmament was the issue to a large section of Union cavalry in the fall of 1864 of the long muzzle-loading Springfield 1863 infantry rifle. These weapons could not be loaded efficiently on horseback, yet Colonel Capron's men endeavored to use them mounted. Forrest's tactics rather than his weapons themselves were responsible for his success.

Artillery also was employed by Forrest to his great advantage from the beginning to the end of the war. He took it everywhere and spared no pains in selecting and training men to make it work. He himself was a competent gunner. He practically committed to memory in one week the Confederate Field Artillery Manual.

Although his pronunciation of words like "ricochet" was a bit unusual, he insisted that everything that would tend to preserve his batteries and increase the individual efficiency of his guns be done exactly.

Artillery Important

His artillery was particularly important to his invasion success. Other cavalry raiders would control only the ground on which their horses stood; they did not usually attack the fortifications of the enemy nor do a great deal of damage to railroads and the like.

Forrest took along his artillery, knocked apart the fortifications protecting bridges and depots, or forced them to surrender by bluff, burned not only the fortifications, but the trestles and mile after mile of cross ties,

destroying the rails for further railway use.

On one occasion he so badly damaged a railroad that it was not repaired by the enemy; it did not get back into operation even after the war.

Used Canister

In the early days, Forrest had only captured brass smoothbore pieces. His first chief of artillery, Captain Freeman, liked best the 12-pounder field howitzer whose most effective ammunition was canister. Freeman employed these weapons at short range, generally with two cans of musket balls in front of a single charge of powder. After the first West Tennessee invasion, however, in which Forrest took two 3-inch steel Rodmans, he began to have a preference for the rifled field guns.

Capt. John Morton, who commanded his artillery after Freeman's death, handled these with unusual ability and precision. These Rodmans and two more captured later became an integral part of Forrest's command.

This preference for rifled guns was on the whole unusual in both armies for serious fighting in the later years of the war. It was due in part to Forrest's love of long-range sharpshooting and the ever present possibility of having to fight gunboats on the three great rivers in his theater of operation. Further, Morton's gunners were the most efficient of all Confederates with explosive shell from rifled guns largely because they were using captured ammunition most of the time.

Wartime accounts of Confederate shell performance, as well as the large number of unexploded projectiles recovered from the battlefields today, indicate the unreliability of Confederate fuzes.

Finally, Morton seems to have been able to fire canister more effectively from his Rodmans than was usual. Perhaps when using canister his pieces were so close to the enemy that the charges did not have a chance to cartwheel.

At one time or another, you will find mentioned mountain howitzers, 20-pounder Parrott rifles, and James rifles in connection with Forrest's operations. The mountain howitzers were never popular because of their poor range and low power; they were discarded as soon as they could be replaced either with standard field howitzers or with field guns.

The 20-pounder Parrotts were taken on one expedition into West Tennessee only and were used especially for fighting gunboats on the Tennessee River. The James rifles were captured in Middle Tennessee in the summer of 1864 and were taken on the Johnsonville expedition soon after.

A Weapons Team

Forrest's greatest weapons contribution was not in the use of any one arm, though he managed to obtain a tactical and usually a comparative advantage out of each, but in the employment of all in a weapons team. In every action he thought of all his arms and employed them in a coördinated plan.

The sharpshooter with his precise but slower loading arm was supported by combat "infantry." Forrest's artillery was always a part of his unified forces. His revolvers were employed in coördination with other arms for short-range power. Finally, horses not only allowed his command to move quickly and arrive reasonably fresh but also to send smaller mounted attacks into the flanks and rear of the enemy.

Forrest was a team man, though he ruled it with an iron hand, and he took full advantage of what he had.

There are men who say that even as late as the fall of 1864 the placing of the Tennessee campaign in the hands of practical realist Forrest, instead of the gallant Hood of Texas, would have meant the salvation of the Confederate cause. Such ideas, while interesting, are entirely hypothetical. The "ifs" of the Confederacy are well-known.

Defensive Strategy

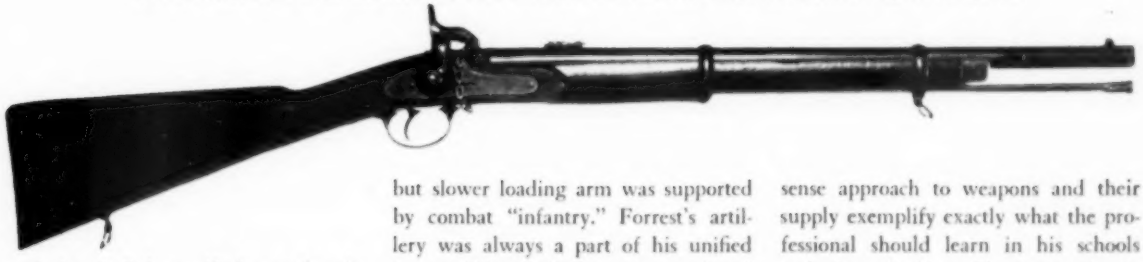
Certainly Forrest's greatest victories which came in Mississippi and Tennessee in 1864 were, despite their offensive audacity individually, part of a defensive over-all strategy.

Why he was not sent against Sherman's communications in the critical four months before the fall of Atlanta is still hard to understand. The world will never know just how good this natural soldier of the wilderness with no formal education would have been with truly large military responsibilities.

Bedford Forrest's weapons message, however, is timeless. He procured the best arms available, taught his soldiers individually to use them, and then integrated the different weapons into a team. That's what we're striving for today.

Forrest eternally refutes the belief that only the professional soldier is capable of commanding armies, yet his own fighting impulses and common-sense approach to weapons and their supply exemplify exactly what the professional should learn in his schools and through his military experience.

Forrest tried to arm all his troopers with the short Enfield rifle which was accurate up to 400 yards.



Still Leading

Brig. Gen. Nathan Bedford Forrest, Jr., U.S.A., was killed in June 1944 at the age of 37 while leading an air attack on Germany. Old Bedford's progeny was still choosing the most advanced of weapons and leading the attack in person.

Month by Month: Highlights of the National Defense

Reserve Production Capacity

Immediate action has been taken on the Association's Blandy Board Report!

The American Ordnance Association, through the report of its special board under the chairmanship of Adm. W. H. P. Blandy, a vice-president and director of the Association, recently submitted to Charles E. Wilson, Secretary of Defense, constructive and farsighted recommendations concerning the preservation of reserve ordnance production capacity.

The Blandy Board recommended that our Government-owned production facilities be maintained in standby during the foreseeable future; that privately owned production lines be kept as nearly as practicable under the jurisdiction of private commercial operators; and that very special Government-owned machine tools be used for educational purposes by the contractor on equitable terms so that the know-how of their use might be preserved for ordnance production.

> *As to the general reserve of machine tools, the board recommended that it be kept intact and stored under proper conditions for future weapons production.*

Secretary of Defense Wilson, having given careful study and consideration to the Blandy Board Report, assured Lieut. Gen. Levin H. Campbell, Jr., president of the American Ordnance Association, that the board's recommendations would become a part of the official policy of the Department.

Implementation of the reserve production capacity recommendations is included in the defense appropriations for 1954. The Senate Appropriations Committee had this to say on the subject:

"The Committee feels that this program, without question, is one of the most important in the entire national-defense effort since it consolidates under the control of the Secretary of Defense funds for the procurement of plants, tools, and production equipment for mobilization reserve purposes.

"However, from the testimony presented to the Committee, it does not appear that plans have been sufficiently developed to warrant a larger appropriation at this time than the $250 million recommended.

"In this connection, the Committee wishes to point out that the Congress has appropriated more than $6 billion for defense-plant expansion since the beginning of the Korean war. The Department estimates that of this amount $600 million remained unobligated on June 30, 1953.

> *"The amount recommended by the Committeee will make $850 million avilable for obligation during the 1954 fiscal year."*

General Campbell made the following comment on the acceptance of the Blandy Board recommendations by the Department of Defense:

"We can all take pride in this recognition of our Association's place in the defense effort and show it best by giving the Secretary and the entire Defense Establishment our full coöperation and support."

Ordnance Research Shift

Defense Secretary Wilson and Secretary of Commerce Weeks have decided upon a transfer of major ordnance research and development work now performed by the Bureau of Standards to the Chief of Ordnance of the Army.

> *The following four of the Bureau's seventeen technical divisions will be shifted to Army Ordnance: ordnance development, electromechanical ordnance, electronic ordnance, and missile development.*

Transfer of the Bureau's defense research was in accord with recommendations by Dr. Mervin J. Kelly, head of the Bell Telephone Laboratories and chairman of a special committee established by Secretary Weeks to evaluate the functions of the Bureau of Standards.

Widespread approval greeted the announcement that "it is felt that for the Bureau to continue indefinitely to perform such major services for the Department of Defense would interfere with its capacity to carry out its basic functions in the standards area which should receive increased emphasis in future years.

"It is the view of both (Defense and Commerce) Departments that activities of such direct importance to the operating needs of the Department of Defense should be carried out within that agency itself."

> *The Department of Defense recognized "the many important and valuable contributions made in the field of ordnance by the Bureau of Standards and the outstanding competence of the staff engaged in this work."*

Under the direction of Dr. A. V. Astin the Bureau has many notable ordnance achievements to its credit in addition to its outstanding rôle as the Nation's standards arbiter. Dr. Astin was one of the leaders in the wartime development of the proximity fuze.

The Bureau also did some of the original research which led to the development of the atomic bomb.

Artillery Ammunition Shortage

The Interim Report of Preparedness Subcommittee No. 2 of the Senate Committee on Armed Services states that evidence has been collected which establishes the fact that there was a continuing shortage of ammunition during the entire period of the Korean war. The subcommittee is under the chairmanship of Senator Margaret Chase Smith of Maine.

> *According to the report, it is clear that, at some time or other, the following important ammunition items were in short supply: 4.2-*

inch mortar, 60-mm. mortar, 81-mm. mortar, 105-mm. howitzer, 155-mm. howitzer, and the hand grenade.

On the basis of the evidence, the subcommittee arrived at the following conclusions:

For two years the bulk of our artillery ammunition needs in Korea were supplied from reserve stocks.

It is evident that it was the firm policy of the United States to run the Korean war without disrupting the civilian economy.

From the beginning of the Korean war, the policy was established which forced the planners to assume that the war would be over on different specific dates stated in the assumptions. Beginning with September 27, 1950, the procurement agencies were directed to proceed on the assumption that the war would be ended July 1, 1951. From then on, even after the Chinese Communists entered the war, the same policy of fixing specific dates for the termination of the war continued for more than two years.

The budgetary structure of the Department of the Army and the Department of Defense needs overhauling.

The need for the elimination of red tape is shown graphically by this sequence:

> *After an appropriation had been signed by the President, a month elapsed before the fund was allocated, an average of five months before a contract was let, and another eighteen months before the first deliveries were made—making twenty-four months in all as the average period between the passage of an appropriation and the deliveries of ammunition.*

The subcommittee quite rightly also insists that the situation described was in no way traceable to a lack of funds as the record reflects that the Congress was fully responsive to all budgetary requests for ammunition.

Senator Smith's subcommittee in its final report on August 12, 1953, gave a far more realistic and equally less critical report. It found that: (1) Many of the limiting policies which had an adverse effect on ammunition production have been altered or removed; (2) There is now in being production capacity capable of meeting needs of foreseeable emergencies; and that (3) The ammunition situation in the Navy and Air Force is satisfactory.

A very substantial service to the national defense was rendered by Senator Smith's subcommittee: Recognition by the Congress of the importance of the national reserve of ammunition on the time-tried principle that *production capacity for all ordnance, plus stocks in being, must always be equal to foreseeable requirements.*

The Senate subcommittee report would seem to highlight the old maxim: "Too many cooks spoil the broth." In the future, the Chief of Ordnance should be given full authority—which he does not now have—to do the job assigned him and should be permitted to put the Industry-Ordnance team to work, when necessary, with an absolute minimum of interference and delay.

Now that there is an end to the fighting in Korea many persons familiar with Pentagon procedures plead that war should be renewed with intensity on red tape.

New Mobilization Plan

A new approach to the problem of materials control, in the event of another national emergency, is being worked out by Government officials in Washington.

The purpose of the plan is to permit the quick rationing of steel, copper, and aluminum by users in the event of a war or mobilization.

> *According to the new approach the Government will go through all the masses of statistics now regularly collected by the Department of Commerce and other agencies in order to find out how much steel, copper, and aluminum is consumed by each of the Nation's industries in producing peacetime products.*

Officials will then compute ratios of metal consumption for the finished products of each of these industries in order to determine just how much of the three metals they will require for various rates of production.

Instead of telling a manufacturer how much steel he can have, the Government would simply authorize the manufacturer to buy all the steel he needs to fill all the orders placed with him by both civilian and defense users. Indirectly, however, the Government would control the manufacturer by clamping down on metal allotments to civilian-goods producers and increasing allowances for defense producers. This would have the effect of gradually shifting the manufacturer's output out of civilian goods and into military equipment.

Whether the new control system would remain intact throughout a future emergency or be used only as a stopgap measure is not known.

Army Procurement

The Army is conducting a number of studies into procurement methods which, in the past, have been sharply criticized as obsolete and inefficient.

> *The Army is seeking to remedy any antiquated procedures in procurement by inaugurating expert studies of methods and systems.*

A uniform stock-accounting system, for example, is now being installed throughout large Army depots and may lead to substantial economies. Such measurement would show where savings can be made and would also set operating responsibility so pointedly that capable executives would be rewarded and incompetent ones would be discovered and probably removed from duty.

A 3-man industrial team is studying Army Signal Corps procurement methods and will make recommendations. The highly qualified team consists of L. K. Alexander, of General Electric Company; R. M. Herrick, of Western Electric Company; and H. M. Zimmerman of the Radio Corporation of America.

In line with this type of study and reorganization the Commission on Government has been reconstituted with former President Herbert Hoover as chairman.

These developments indicate the need for streamlined, economical operations.

British Ammunition Team

The British Productivity Council published a report of fourteen British ammunition experts who came to the United States early this year as members of the first team from the United Kingdom to make studies directly related to the rearmament program.

> *The study was sponsored by the Mutual Security Agency and the Anglo-American Council on Productivity under MSA's productivity and technical-assistance program.*

The team visited U. S. Ordnance headquarters, arsenals, and firms producing ammunition components, obtaining information which might accelerate production and supply of urgently needed armament stores and components in the United Kingdom.

"We were well aware at the outset that we were launched on an exploratory mission in different circumstances from those which hold good for a team going from an established industry in the U.K. to a similar industry in the U.S.," the team's report declared.

"Perhaps the most significant difference in the factors affecting productivity in relation to armaments is that in our two countries there is virtually no armaments industry in peacetime in the same sense that there are, for instance, aircraft, shipbuilding, and automobile industries.

"In effect, therefore, in a period of rearmament a new and temporary industry must be organized under Government auspices. This necessarily involves the integration of existing engineering industries, the creation of new specialized capacity and plants, and the reactivation of plants held in reserve against such an emergency."

Our British guests have stated in crisp language the problem the American Ordnance Association has been trying to help our country solve for the past thirty-five years.

Tactical Air in Europe

Tactical Air Command's contribution to national defense was recently highlighted by the announcement that the 50th Fighter-Bomber Wing, now stationed at Clovis Air Force Base, N. Mex., is being deployed to the Western Zone of Germany for duty with the NATO forces.

> *The 50th is the first wing fully equipped with new North American F-86F "Sabrejet" fighter-bombers to be sent overseas by the Air Force. Another wing, the 86th Fighter-Bomber Wing, located in the U. S. Zone of Germany, is in the process of replacing other equipment with the new F-86F.*

Since its establishment as a major command of the U. S. Air Force, TAC has trained and deployed a total of twelve wings, brought to combat readiness to strengthen the NATO forces in Europe or to fight in Korea.

Nine of the wings have been sent to bases in England, France, and Western Germany. Three other wings have distinguished themselves during lengthy tours in Korea.

National Resources Studies

An important and well-conducted course of study will be given by the Industrial College of the Armed Forces during the coming months. Formerly known as Economic Mobilization Courses, these study groups in future will be called National Resources Conferences.

These courses are open to selected senior members of industry, civil life, and the civilian components of the armed forces.

> *The scope of the 2-week course will be to present the problems which would confront the country in a full mobilization of the national economy for war; to show the resources and economies of potential belligerents, allies, and neutrals; and to examine methods and procedures for making the best use of our resources.*

The places and dates of the sixteen seminars for the coming 1953-1954 season are as follows: Boston, Mass., September 21–October 2, 1953; Schenectady, N. Y., September 28–October 9; Kansas City, Kans., October 19–30; Nashville, Tenn., October 26–November 6; Boise, Idaho, November 9–20; Cincinnati, Ohio, November 30–December 11; Oklahoma City, Okla., November 30–December 11; San José, Calif., January 18–29, 1954; New Orleans, La., February 1–12; Dallas, Tex., February 8–19; Wilmington, Del., March 1–12; Atlanta, Ga., March 8–19; Pasadena, Calif., April 5–16; Pittsburgh, Pa., April 5–16; Omaha, Nebr., April 26–May 7; and Minneapolis, Minn., May 3–14.

New U.M.T. Study

President Eisenhower filled the three vacancies of the National Security Training Commission by sending to the Senate the names of Maj. Gen. Julius Ochs Adler of New York, Dr. Karl T. Compton of Massachusetts, and Warren Atherton of California.

> *Present members of the Commission are Lieut. Gen. Raymond S. McLain, Retired, and Adm. Thomas C. Kinkaid, Retired.*

The President also directed the reconstituted 5-member group to report to him by December 1st on the feasibility and desirability of operating a military training program to supply trained nonveteran reserves concurrently with operation of a Selective Service System to provide men for the armed forces.

General Adler was designated chairman of the Commission. The assignments are part-time and do not interfere with the regular activities of the members in their private fields.

Streamlining the Marines

The Marine Corps is reorganizing its military job structure in a manner that will deëmphasize specialization.

Approximately 200 military occupational specialties have been eliminated, and 29 new military occupational specialties have been authorized.

Some of the cuts resulted from a complete or partial merging of two or more specialties in the same category.

Under the new plan, Women Marines will be given more job opportunities—thus releasing more men for duty in the field.

The Korean Truce

An Editorial

THE Korean armistice marks the first time in history that hostile aggression was checked by the forces of an international organization.

To view the Korean truce in proper perspective, however, it should be noted that the temporary termination of hostilities marks the first war in our history in which victory was not the goal. And the cost to the United States was tragic: some 136,720 Americans killed, wounded, and missing. Against this the cost in money—some fifteen billions of dollars—is belittled.

After more than three years of bitter and costly warfare we found ourselves confronted with a choice between continued carnage and continued frustration under the rules laid down by the United Nations.

Although many aspects of the Korean armistice are equivocal and ambiguous, there is nothing fuzzy or obscure about the number of American casualties in this strange war in the Far East.

For the period through midnight of Friday, July 10, 1953, the total number of American deaths was 24,804. Our Army lost 20,303 men, the Navy 384 men, the Marine Corps 3,582 men, and the Air Force 535 men.

The number of American boys wounded in action was 100,597. The Army list totaled 76,236, the Navy record was 1,532, wounded Marines numbered 22,782, and the number of Air Force wounded was 47.

The total number of American fighting men captured or missing in action was 11,319. Of this total, 9,771 were Army personnel, 96 were Navy men, 573 were Marine fighters, and 879 were Air Force men.

The cost of repelling Communist aggression has been high. As President Eisenhower declared in his address on the truce, it is with special feelings of sorrow and with solemn gratitude that we think of those who were called upon to lay down their lives in that far-off land "to prove once again that only courage and sacrifice can keep freedom alive upon the earth."

Economic Consequences

The economic consequences of the truce will not be immediately evident. Defense spending will continue for some time in order to build up our own depleted stocks, to replace obsolescent matériel, and to increase badly needed supplies to friendly European nations. When these goals have been achieved, it is probable that expenditures will slow down. Instead of a defense spending of some $43 billion a year, as at present, total outlays for the armed forces might gradually drop to about $35 billion a year.

Assuming that no new wars break out, immediate budget economies will almost certainly be eaten up by spending for an ambitious South Korean reconstruction program that will cost American taxpayers at least a billion dollars.

Draft calls may decline from 23,000 men a month to 19,000, but they are almost certain to increase next year when many 2-year enlistments are due to expire.

The most serious danger confronting our Nation today is the strong temptation to repeat the demobilization tragedy of 1945-1946, to let down our guard and dissipate our military-naval-air strength, to become the unthinking victims of another round of phony Communist peace propaganda, and to indulge in a lot of wishful thinking that will delude us into believing that the Korean truce was the end of a war instead of the stalemated, negative, and inconclusive end of a single campaign in a global struggle for the world.

Program for Defense

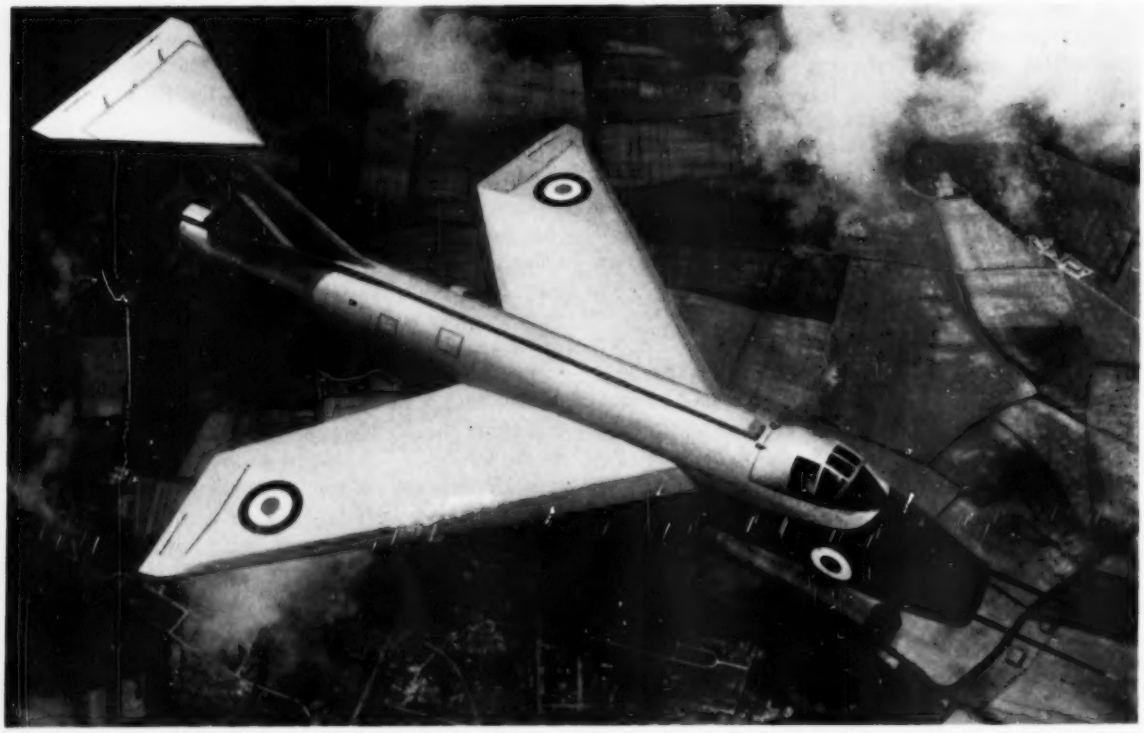
A few weeks ago Defense Secretary Charles E. Wilson addressed a week-end conference of top civilian and military leaders at Quantico, Va. All patriotic citizens should give careful consideration to the following ten points which, Mr. Wilson asserted, will contribute to progress in our defense effort:

1. The organization and activities of the new joint Chiefs of Staff.
2. The reorganization plan for the Department of Defense and the personnel to implement it.
3. The revision of the fiscal year 1954 budget and the basis for the fiscal year 1955 budget.
4. A modernized and standardized accounting system for the three services and the Defense Department.
5. A reorganization of the three military departments broadly based on the principles of the Rockefeller Committee Report.
6. The building up of the morale and the coöperative attitude of the entire Defense Department, both military and civilian.
7. Establishment of effective working relations with the Office of Defense Management and effective industrial support for possible military requirements, including dual-purpose plants and making sure that necessary critical materials are or will be available to meet requirements.
8. Establishment of improved working relations with the Atomic Energy Commission and the taking of a continuing interest in the development of new weapons and their use by the services.
9. Development and maintenance of a strong ready reserve of trained personnel.
10. Working out relations with the Congress so that the needs of the Defense Department will be better understood both by the Congress and the people of the country as a whole.

In other words, in the name of the 24,804 American heroes killed in the Korean War, KEEP AMERICA STRONG!

New British Aircraft

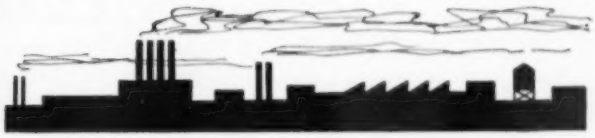
A recent photo of Britain's mightiest operational jet bomber, the Handley-Page Victor, above, shows its crescent wing, said to combine the best features of the delta, the swept-back, and the thin straight wing. The Short S.B. 5 research aircraft, below, can vary the sweep of its wings to as much as 50 degrees and the position of the tail plane (British photos).



Reg. U. S. Pat. Off.

INDUSTRIAL PREPAREDNESS

a monthly report on current scientific and logistical developments as they relate to the national defense



AMERICAN ORDNANCE ASSOCIATION • *Founded in 1919* • 705 MILLS BUILDING, WASHINGTON, D. C.

No. 83 September 1953

● **Arthur S. Flemming, Director of Defense Mobilization** in the Executive Office of the President of the United States, following consultation with members of the Defense Mobilization Board has recently issued the following policy statement in connection with the mobilization readiness of this country. It is believed that this relatively brief, yet very comprehensive statement of policy which will govern the mobilization planning of the United States will be read with great interest by all members of the American Ordnance Association.

* * *

For nearly three years this Nation has been engaged in a very substantial program for the expansion of productive capacity to a point adequate for long-term readiness against attack upon us and our allies. The major statutory basis for the program has been the Defense Production Act, the extension of which was approved recently by the Congress. The purpose of that act, as stated in the opening declaration of policy, is "to provide for the national defense and national security."

In this connection, the over-all objective of the military and civilian organizations is to develop a mobilization plan that lies within our material and fiscal resources and yet generates the maximum military power that those resources can support with due consideration of the needs and contributions of the rest of the free world.

Toward this end we are (1) measuring the production potential of our industry for hypothetical war years as well as the support we will receive from the materials and facilities of the free world; (2) estimating rock-bottom civilian requirements; (3) estimating the share of the production potential that by preliminary tests it seems possible to allot to war goods and the impact of that allotment on the economy; (4) testing the ability of specific industries to supply the principal tools, equipment, components, subassemblies, materials, and skills needed to produce the pattern of weapons desired by the military within its allotment; (5) identifying deficiencies; and (6) estimating exports from the United States essential for the security of the free world.

Thus the ground will be laid for decisions as to whether to fill in gaps in the national plant or modify the military plan or both. In either event, some of the costly diversions of resources from weapons production to plant expansion, and most of the two years' loss of time before a high level of weapons production was attained in World War II, can be telescoped or avoided.

In those cases where the analyses that are now being made indicate that we should expand capacity, that expansion will presumably be concentrated on providing long lead time, difficult-to-produce and critical types of tools, equipment, instruments, materials, energy, and technically trained personnel.

The result will not be an economy geared meticulously to the requirements of war production, which would be far too expensive, but the development of a program which will provide us with an industrial position, or plans for it, from which we could move rapidly to maximum rates of balanced output of war and war-supporting goods.

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Our main increments in strength for defense as well as for the maintenance of a sound civilian economy will continue to derive from the normal expansion of industry within the workings of the free-enterprise system.

It is clear, nevertheless, that no matter how powerful our industry may become, its organization for a peacetime economy can never be the same as that for the needs of war. This means that gaps in the way of specialized resources will have to be filled in before we can swing large parts of our great peacetime capacity into the actual production of war goods.

By supplying or planning for the filling in of these gaps on a highly selective basis, we should be able to (1) plan the largest balanced military program falling within the limits of fiscal and industrial resources; (2) develop an industrial organization capable of supporting a military program adequate to our security; and (3) achieve economy both in the use of our resources and in the immediate burdens placed on industry.

In addition, the closest possible correlation between United States and foreign mobilization readiness measures is required in order to place NATO and the rest of the free world in a position to support the maximum war effort.

Through attainment of these objectives, we can lessen dependence on large reserve stocks of end items, at the same time recognizing the necessity of having available certain minimum essential reserve stocks of end items to support the war effort until war production reaches the required level.

The choice in each case will be made on the basis of what will provide the Nation with a defense program of maximum effectiveness over the long pull—with a program that will make it possible for us to shift from a civilian economy to a war economy in the shortest possible period of time.

Many departments of the Government are participating in the mobilization-readiness program. Industry committees now advising the National Production Authority in the Department of Commerce will be utilized in making the final checks on the extent of critical deficiencies.

The success of this program requires (1) all practicable action by Government and industry to reduce the vulnerability of industry to atomic attack; (2) imaginative planning by business and Government to insure quick rehabilitation of strategic plants damaged by atomic attack; and (3) systematic maintenance of all productive facilities essential to the mobilization base to prevent dismantling or loss of effectiveness through disuse and lack of care.

● **The four Army Field Forces Boards and the Arctic Test Branch** which service test new equipment and weapons for the Army have been placed under direct command of the Chief of Army Field Forces. These field agencies have been designated as Class II activities and will be organized as subunits of the Office, Chief of Army Field Forces, at Fort Monroe, Va.

Board No. 1, based at Fort Bragg, N.C., conducts service tests of Army aircraft, heavy weapons (other than man-carried), communications and electronics apparatus, and airborne equipment.

Board No. 2 is stationed at Fort Knox, Ky., and conducts service tests of new armored vehicles and all automotive, engineer, and medical equipment for units of the Army Field Forces.

Board No. 3, at Fort Benning, Ga., service tests new light infantry weapons (machine guns, mortars, and individual weapons), chemical and quartermaster equipment utilized in the field, and clothing and accessories for the individual soldier.

Board No. 4, located at Fort Bliss, Tex., conducts tests of guided missiles and new antiaircraft weapons and equipment.

The Arctic Test Branch, at Big Delta, Alaska, tests selected items for suitability for use under Arctic conditions.

The boards and the test branch formerly were controlled in administrative matters by the continental Army or post commander, depending on the location, with the Chief of Army Field Forces supervising their operations. Under the new status, the Army or post commander will support rather than control administration matters, and the Chief of Army Field Forces will control the personnel as well as the operations.

The change is designed to keep the Office, Chief of Army Field Forces, fully informed of the capabilities of the boards and the test branch, as determined by their personnel strength and facilities for testing. As a result, assignment of testing activities will more closely parallel the capabilities of each of these units.

● **The Army's newest medium tank,** the Patton 48, will soon be issued to troops here and abroad, the Department of the Army said recently. Sizable quantities of the new Pattons already have been produced under Army Ordnance contracts, and original issues to troops will be made from this supply.

Patton 48 tanks, designed by Army Ordnance and the Chrysler Corporation, are in production at Chrys-

ler's Newark Tank Plant in Delaware, Fisher Body Division of General Motors Corporation in Grand Blanc, Mich., and the Ford Motor Company in Livonia, Mich.

● **The Army's offshore procurement program** reached the billion dollar mark recently with the placement of a $2 million order with an Italian concern for the manufacture of cartridges.

The Italian contract was one of approximately 100 signed with 12 West European nations since the program began in April 1952.

In addition to supplying our allies with much-needed dollars, the offshore procurement program creates new sources of supply for the Army and saves the United States money through the cost differentials in production and delivery expenditures.

The Ordnance Procurement Center, under the command of Col. Joseph M. Colby, signed its first offshore contract on May 2, 1952, with Norway. Since then, orders have been placed in the various West European countries for items ranging in cost from $49,000 to $100,730,000.

● **The Army Ordnance Corps,** maker and handler of vast quantities of high explosives, has won the Nation's highest safety award for the second straight year. The award was presented to Maj. Gen. E. L. Ford, Chief of Ordnance, by Ned Dearborn, president of the National Safety Council.

In earning the nationally recognized honor, Army Ordnance was given outstanding scores in seven of the eight safety area rates—an unusual accomplishment because of the very nature of ordnance activity which, in addition to explosives, develops, produces, and supplies the heavy munitions of war. In addition, twelve Ordnance installations were singled out for individual safety awards.

The accident-frequency rate to employees at Ordnance installations in 1952 was 45.3 per cent lower than in 1950 and the occurrence of fatal injuries was 33 per cent lower, yet the number of man-hours worked had tripled. As a result of these reductions, 13 deaths and 1,300 injuries were prevented during 1952. According to Army accident cost data, about $3.75 million were saved as a result of the Ordnance safety program.

● **Problems involved in speeding up deliveries of titanium products** to military contractors were discussed recently at a meeting between the Titanium Producers and Fabricators Industry Advisory Committee and the National Production Authority, Department of Commerce.

Government spokesmen stated that producers and fabricators of titanium will soon be asked to reschedule deliveries to military contractors. Such action, they said, is urgently needed because of a lag which developed in production and delivery of critical items due in May and June.

Members of the committee said the lag was due in part to a "shortage" of titanium sponge, the material from which sheet, bar, plate, and other forms and shapes are produced. Government spokesmen said expansion programs are being undertaken to increase production of titanium sponge and that it is hoped the expected 1953 output of 3,400 tons may be increased by 1956 to an annual rate of about 18,600 tons.

Titanium metal, said to have been produced in the United States for the first time in 1944, has been found excellent material for numerous military applications. The metal is light in weight, extremely strong, and withstands extraordinarily high temperatures. Technological advances in its production and fabrication are being made rapidly, with a view not only to increasing the Nation's supply but also to reducing the high cost of production.

Titanium sponge is manufactured from rutile, found in certain sands, and from such other materials as ilmenite, brookite, and high-titania slag. Because the availability of rutile is limited as compared with other materials, Government representatives told the committee that industry must be capable of using the alternative materials.

A task group representing titanium fabricators reported to the committee that melting capacity already substantially exceeds the ability of sponge titanium producers to provide raw material. This group also reported it has made a study of facilities available to fabricate forms and shapes of titanium. Summarizing, the fabricators reported that melting and rolling capacity do not represent so great a problem in the industry as the production of titanium sponge.

● **The Government plans to buy approximately $12 million worth of machine tools** in the near future for the production of ammunition, the commanding general of the Army Ordnance Ammunition Center at Joliet Arsenal, Joliet, Ill., announced recently.

The orders will be placed by individual contractors but the tools will be paid for by the Government, a

FUTURE SCHEDULED MEETINGS OF NATIONAL TECHNICAL DIVISIONS AND SPECIAL COMMITTEES OF THE AMERICAN ORDNANCE ASSOCIATION

- **Casting Subcommittee, Shell Committee of the Rocket, Bomb and Artillery Ammunition Division, September 1953.**
- **Rocket Committee of the Rocket, Bomb and Artillery Ammunition Division at Redstone Arsenal, Huntsville, Ala., November 5-6, 1953.**
- **Metal Lubricants Committee at Cincinnati, Ohio, November 1953.**

spokesman for the ammunition center said. The orders are approved by the Ordnance Department before they are placed, he added.

These orders will be in addition to some $30 million worth of machine tools already on order. These tools will go to 70 firms holding Ordnance Corps contracts. Some of this equipment has been backordered on the books of machine-tool makers for as long as eight months, although the average period is about six months. These machine tools include shell-turning lathes, presses, screw machines, and grinders.

The ammunition center does no purchasing itself but it schedules production and supervises the Government's $2.5 billion annual ammunition program.

● **Two new leaflets** designed to assist small businessmen engaged in defense production have been announced by William D. Mitchell, Administrator of the Small Defense Plants Administration.

The leaflets are "Packaging Pointers for Government Contractors," Number 31 in the series of management aids; and "Gaging Tolerances in Machine Shops," Number 27 in the technical-aids series. They are available free at all SDPA field offices.

The management-aid leaflet discusses packaging problems typical of those encountered by firms engaged in defense production. It points out that many manufacturers fail to consider that packaging requirements of the Government are often much more stringent than those followed in ordinary commercial practice.

"One common problem," the leaflet says, "is that packaging costs, which may be considerable—at times even more than production costs—are not fully taken into account in the price quoted at time of bidding. But every element of packaging cost must be included. You risk your profit from the contract if you overlook or underestimate this item of cost."

The leaflet explains the common packaging requirements under Government contracts and outlines the points relating to packaging that should be considered before a bid is submitted.

The technical-aid leaflet explains the meaning of gaging tolerances used in specifications on defense contracts and was prepared particularly for the use of the man in the shop, to increase his "tolerance consciousness," so he can produce products meeting rigid specifications more quickly and more economically.

● **Priorities assistance** will be continued for defense contract laboratories but withdrawn for all other laboratories, the National Production Authority, Department of Commerce, has announced.

Through issuance of Direction 3 to Defense Materials System Regulation No. 1, NPA has retained for defense-contract laboratories the self-authorization procedure and priorities assistance of Order M-71. These laboratories may obtain products and materials needed to carry out projects covered by contracts made by or for the Department of Defense or the Atomic Energy Commission bearing a DO rating including the letters A, B, C, D, or E and one digit.

NPA also revoked Order M-71, effective July 1st, thus terminating the present broad system of priorities assistance to all laboratories. Order M-71 was issued June 26, 1951, at the outset of the Controlled Materials Plan, to help scientific laboratories obtain the small quantities of materials needed to carry out research activities, particularly those aiding national defense and industrial expansion.

NPA officials said that Direction 3 to DMS Regulation No. 1 recognizes the special needs of laboratories working on vital defense research and development projects. Since defense research commonly involves new methods and processes, laboratories must be able to obtain equipment and supplies on short notice.

Direction 3 allows defense contract laboratories to use the allotment number B-5 and the rating DO-B-5 in obtaining any material or product, except for construction, needed to carry on scientific or technological investigation, testing, development, or experimentation. Such orders, including those for maintenance, repair, and operating supplies, may be self-authorized, without application to NPA, under DMS Regulation No. 1 and NPA Regulation No. 2.

The James L. Walsh

PRIZE ESSAY CONTEST

$1,000 in CASH

. . . to a young A.O.A. member

Award will be presented at the Thirty-fifth Annual Industrial Preparedness Dinner Meeting of the Association at the Waldorf-Astoria, New York, December 2, 1953

Rules of the Contest

1. The contest is open to all members of the Association who are under thirty years of age.

2. The topic for the 1953 contest will be:

"It is sometime. said that modern weapons have become so complex that their use and maintenance can be assured only by engineers and technicians of more than average skills. Discuss the truth of this opinion in the light of manpower limitations and what steps might be taken to assist in the solution of the problem."

3. Essays must be submitted on or before October 1, 1953.

4. Articles must not exceed 3,000 words.

5. Essays must be typewritten, double-spaced, on paper approximately 8½ by 11 inches, and must be submitted in triplicate, each copy complete in itself and firmly bound together.

6. The name of the competitor must not appear on the essay. On the essay a *nom de plume* will be used. The name and address of the contestant must be typed on plain paper and inserted in a plain sealed envelope on the front of which his *nom de plume* must be written.

7. Essays with identifying envelope must be mailed in a large sealed envelope marked "Walsh Prize Essay Contest," to the Secretary, American Ordnance Association, 705 Mills Building, Washington 6, D.C.

The prize-winning essay will be published in ORDNANCE magazine, and all other essays submitted will be considered for publication. Authors of nonprize-winning essays will be paid the usual publication rates for articles if published in the magazine.

If you know of an interested young man who is not a member of the A.O.A. see that he becomes eligible today!

Contest closes October 1, 1953

ASSOCIATION AFFAIRS

Western Michigan Chapter Celebrates Armed Forces Day with Annual Meeting

The annual meeting of the Western Michigan Chapter of the Michigan Post, American Ordnance Association, was held in Muskegon, Mich., on May 15th in conjunction with the observance of Armed Forces Day.

The activities began with the registration of members and their guests at the military engine plant of Continental Motors Corporation.

After a welcoming address by C. J. Reese, president of Continental Motors, a conducted tour of the plant was followed by a very extensive exhibit of military equipment arranged adjacent to the plant.

Particular thanks are due to the personnel of Continental Motors for their efforts in making the plant tour and exhibit so comprehensive and instructive. An additional pleasant feature of the event was the music furnished by the 100-piece Muskegon High School championship band.

The luncheon program at the Occidental Hotel which followed the industrial field trip was attended by 200 members and guests.

The program was most ably conducted by Don M. Compton, civilian aide to the commanding general, Fifth Army, as master of ceremonies. Mr. Compton, well-known for his outstanding Ordnance service during the Second World War, is a former chief of the Chicago Ordnance District.

Distinguished guests at the speaker's table included Charles W. Brownell, National Bank of Detroit; S. K. Harrington, Detroit-Michigan Stove Company; A. B. Willi, Continental Motors Corporation; Britton L. Gordon, Blackmer Pump Company; Brig. Gen. Paul M. Seleen, Detroit Ordnance District; Henry T. Bodman, National Bank of Detroit; Mr. Reese; Maj. Gen. Harry A. Johnson, commanding general, Tenth Air Force; Charles T. Fisher, Jr., National Bank of Detroit; George H. Roderick, American Seating Company; Roger Waindle, Cannon-Muskegon Corporation; and Henry J. Sullivan, Detroit Edison Company.

The principal address was given by Brig. Gen. H. M. Toftoy, the Army's top guided-missile and rocket authority. Drawing upon a wealth of experience, the guest speaker took his audience on a most informative and instructive descriptive tour that ranged all the way from the early beginnings of the rocket program through the latest developments in this most important field of ordnance work.

General Toftoy is the director of the Army Ordnance Missile Laboratories at Redstone Arsenal, Huntsville, Ala.

Before going to Redstone, General Toftoy was in the Office of the Chief of Ordnance of the Army as chief of the Rocket Branch, Research and Development Division.

The entire directorship of the Chapter worked unceasingly to make the meeting a success. Particular thanks are due to Mr. Waindle, chairman of the committee in charge of the meeting, for his work in arranging this outstanding event.

Directors of the Western Michigan Chapter are Mr. Gordon, secretary; Elisha Gray, II; Mr. Harrington; Mr. Roderick; Frederick Vogt; and Mr. Waindle.

When the members of the Western Michigan Chapter visited the plant of Continental Motors Corporation, the 21,250th engine made by Continental was presented to the Detroit Ordnance District, represented by Brig. Gen. P. M. Seleen (center), by C. J. Reese (right), Continental president, and A. B. Willi, vice-president.

• **AT DETROIT.**—The following letter was sent to all members of the Michigan Post on June 24th:

"We are honored in that Friday, July 10th, has been designated 'Father and Son Day' for the membership of the Michigan Post, American Ordnance Association, at the sixth annual International Aviation Exposition which will be staged at the Detroit-Wayne Major Airport, July 9th to 12th.

"The day's program is to be a very fine and elaborate one. From 2:00 p. m. to 4:30 p. m. there will be several formation flying exhibitions and special flights of jet fighters, jet bombers, 400-man troop transports, and troop-carrying helicopters. On the ground there will be exhibits of duplicates of the above aircraft, new international airliners, flight-control demonstrations involving radio, radar, and other electronic equipment, aircraft engines and aircraft test equipment.

"Of special interest to suppliers and manufacturers, because this date is also 'Aviation Industry Day,' procurement representatives from the Army, Navy, and Air Force will be on hand in quarters near the stands to give information on methods of submitting bids, quotations, etc., on defense items now required by the various services. . .

"We hope you will take advantage of this opportunity to see 1953's premier aviation event and will join with us in making the day a big succes—for both dads and sons."

The letter was signed by Henry T. Bodman, president of the Michigan Post, and by Charles L. Jacobson, first vice-president of the Post and chairman of its Activities Committee.

R.O.T.C. cadets who received A.O.A. awards at the Aberdeen Proving Ground summer camp for 1953 (Army photo).

Back row, left to right: D. W. Cronin, The Citadel; G. E. Luper, Arkansas State College; J. E. Baskerville, Alabama Polytechnic Institute; R. E. Milholland, University of Cincinnati; E. V. Risher, The Citadel; J. T. Parkerson, Georgia Institute of Technology; J. E. Dempsey, Clemson Agricultural College; T. M. Griffin, Clemson Agricultural College; W. L. Purcell, Georgia Institute of Technology; D. W. Blacksher, Dartmouth College; J. E. Hess, Marshall College; R. R. Dickey, University of Illinois; W. C. Long, Kansas State College; W. M. Raymond, Lafayette College. *Front row, left to right:* E. D. Bateman, Louisiana State University; E. A. Graves, Louisiana State University; C. H. Konkle, Michigan State College; R. C. Rank, University of Minnesota; J. L. Eller, Purdue University; J. T. Farris, San Jose State College; A. E. Harrell, North Carolina State College of Agriculture and Engineering; C. P. Morris, Pennsylvania Military College; W. E. Whittington, Alabama A. and M.; C. C. Webb, Texas A. and M.; J. T. Frasier, Virginia Polytechnic Institute; W. H. Sneed, University of Tennessee; G. M. O'Kane, Texas A. and M.; G. R. Curtis, Utah State Agriculture College.

Reserve Cadets Receive Commissions after Ordnance R.O.T.C. Camp

One hundred and ninety-five cadets received Reserve commissions as second lieutenants as Aberdeen Proving Ground's 6-week Ordnance Reserve Officer Training Corps Summer Camp came to a close on July 31st. A total of 1,257 college students attended.

Maj. Gen. Jonathan L. Holman, post commander, presented the commissions to the new lieutenants at the formal graduation ceremonies closing the camp. The newly commissioned graduates of Purdue University and Georgia Institute of Technology received their college diplomas at the same time.

Six outstanding cadets, one from each company, were selected to receive a special commendation over the signature of the Chief of Ordnance, Maj. Gen. E. L. Ford. They were, Daniel W. Cronin, The Citadel; John T. Parkerson, Jr., Georgia Institute of Technology; James E. Hess, Marshall College; Ernest D. Bateman, Louisiana State University; James L. Eller, Purdue University; and Conrad C. Webb, Texas A. and M.

Col. Leo A. Codd, executive vice-president of the American Ordnance Association, presented A.O.A. awards to twenty-two outstanding cadets—one from each platoon. The Ordnance Association awards are made on the basis of demonstrated leadership, performance of military duties, and interest shown in the training program. Brig. Gen. Burton O. Lewis (Ret.), of the A.O.A. staff, awarded Association certificates of honorary membership to the cadets.

The 195 cadets who pinned on second lieutenant bars briefly before returning to civilian clothes until called to active duty with the Army represent 42 colleges and universities, and 23 States. Those who were rated as distinguished military students were eligible to apply for Regular Army commissions.

One such cadet has met all requirements and is scheduled for active duty as a Regular Army officer. He is W. E. Whittington from Oklahoma A. and M.

Maj. Gen. J. L. Holman, post commander, awarded athletic trophies and medals to the champions and runners-up in softball, volleyball, tennis, golf, and ping-pong.

Brig. Gen. Willis R. Slaughter, camp commander, joined Lieut. Col. William B. Chase, deputy commander, in stating that the 1953 R.O.T.C. camp was the most successful training camp in his experience and was due in large measure to the exceptionally fine spirit of coöperation displayed by the cadets. A final parade by the entire battalion of cadets climaxed the six weeks of intensive training at Aberdeen Proving Ground.

• **AT SEATTLE.**—The Puget Sound Post, Seattle, Wash., recently elected the following officers: C. Walter Huffine, Massachusetts Mutual Life Insurance Company, president; Alex Thompson, Pacific Car & Foundry Company, vice-president; and Fairman B. Lee, Fairman B. Lee Company, secretary-treasurer.

New members of the executive committee include Murray Aitken, Kenworth Motor Truck Corporation; Joseph A. Denn, Pacific Powder Company; Watt Fallis, Kenworth Motor Truck Corporation; Paul Forsyth, Western Gear Works; H. P. Lawrence, Northwest Lead Company; George C. Martin, Boeing Airplane Company; Robert Nelson, Standard Service Tire Company; Ferdinand Schmitz, Berger Engineering Company; Walter Toly, Columbia Electric Company; and M. J. Williams, Seattle Office, San Francisco Ordnance District.

• **R. H. KENT,** noted ballistician and associate technical director of the Army Ordnance Ballistic Research Laboratories at Aberdeen Proving Ground, Md., was presented with an honorary degree as doctor of sciences by Harvard at the university's commencement exercises in Cambridge on June 11th.

Dr. Kent, a charter member of the American Ordnance Association, was cited for his work as a pioneer in the field of ballistics. The citation stated that "he measures explosive forces in a world of violence and predicts where modern arrows shot into the air shall come to earth."

Mr. Kent has been a leading figure in the field of Ordnance ballistics since World War I. He was an instructor in electrical engineering at the University of Pennsylvania when the United States entered the conflict. He entered the officer training camp at Fort Oglethorpe, Ga., and was commissioned a first lieutenant in Ordnance in December 1917.

He has been stationed at Aberdeen Proving Ground since 1922, conducting research in numerous phases of ballistics and the development of ballistic instrumentation.

In 1946 he received the Medal of Merit, the highest honor awarded for civilian service to the Army.

• **HENRY N. MARSH** of the explosives department, Hercules Powder Company, and general chairman of Technical Divisions and Committees of the American Ordnance Association, has been loaned

by Hercules for special service to the Army Ordnance Corps at the request of the Ordnance Officer, European Command.

Colonel Marsh left Washington on June 5th for Frankfurt, Germany, and reported for duty with the commanding officer of the Ordnance Procurement Group, Heidelberg, Germany, as propellent-powder and high-explosives expert.

The duty was similar to a short tour last fall in Italy where Colonel Marsh assisted in plant surveys in order to evaluate capacity to manufacture ammunition for use in the Ordnance offshore ammunition-procurement program.

From time to time he assisted the Ordnance procurement staff in arriving at decisions on quality of product and in allowing deviations from specifications in order to permit maximum use of available capacity.

Colonel Marsh was formerly a member and vice-chairman of a NATO Task Group to determine what capacity to produce satisfactory ammunition still existed in 1950 in member countries.

• **J. CARLTON WARD, JR.**, member of Council of the American Ordnance Association, was recently elected president of the Vitro Manufacturing Company, the Vitro Corporation of America, and the Vitro Chemical Company. He was also made a director of these companies.

Mr. Ward has been an outstanding engineer and executive and in recent years has been prominent in the aircraft industry.

From 1935 through 1940 he was vice-president and general manager of the Pratt & Whitney Engine Division of United Aircraft Corporation. From that date until 1949 he was president and later chairman of the board of the Fairchild Engine and Airplane Corporation.

From 1949 to 1953 he was chairman of the board of Thompson Industries, Inc., of Boston, Mass., and has been engaged as a business consultant.

At Fairchild Mr. Ward guided the development of the "Flying Boxcar" for the Air Force and also founded and headed, for the Air Force and the Atomic Energy Commission, the project of nuclear energy for the propulsion of aircraft, a coöperative enterprise of ten outstanding American companies. He is also a member of the board of advisers of the Industrial College of the Armed Forces.

• **AT CINCINNATI.**—Matthew C. Patterson, Jr., a senior in the College of Business Administration, University of Cincinnati, was selected as the recipient of the American Ordnance Association scholarship key awarded annually to the outstanding students in Ordnance R.O.T.C. units. Mr. Patterson majored in industrial management and was commissioned a second lieutenant in the Ordnance Corps upon completion of summer camp training in August.

David W. Wickham, a senior in the College of Mechanical Engineering, University of Cincinnati, was selected to receive the A.O.A. scholarship key presented by the Cincinnati Post of the American Ordnance Asociation. Mr. Wickham received the highest grade of all engineering students in the state professional engineer in-training examinations in January. He was commissioned a second lieutenant of Ordnance upon completion of summer camp.

Richard S. Brown, Jr., a sophomore in the College of Mechanical Engineering, University of Cincinnati, was selected to receive the Army Ordnance Association Bronze Medal presented by the Student Chapter of the Association at the university.

John F. Darst, a prejunior in the College of Electrical Engineering, University of Cincinnati, was selected to receive the Reserve Officers' Association Silver Medal presented by the Cincinnati Chapter of the Reserve Officers' Association.

All these students were enrolled in the R.O.T.C. Ordnance Unit at the University of Cincinnati.

• **AT ABERDEEN.**—Officer Candidate Howard R. Hodges was selected from Ordnance Officer Candidate School Class No. 98 as the recipient of the American Ordnance Association scholarship key.

Lieutenant Hodges served three years and four months in the Ordnance Corps prior to attending the Leadership School at Aberdeen Proving Ground, Md., from which he was graduated recently.

He entered the Ordnance Officer Candidate School in September 1952 and was graduated in February 1953.

Officer Candidate Joseph D. Lang was selected to be the recipient of the American Ordnance Association scholarship key in Ordnance Officer Candidate School Class No. 100.

Lieutenant Lang graduated with honors from Peekskill Military Academy in 1949. He entered the Army in 1952 and was graduated from Ordnance Officer Candidate School in April.

Necrology

• **ABNER YOUNG LEECH, JR.**, a charter member of the American Ordnance Association and an honorary life member, died at his home, Chevy Chase, Md., on June 27th after a long illness.

Mr. Leech founded the United States Ordnance Company in 1902 and managed its affairs since that time, working closely with the Army Ordnance Corps and the Bureau of Ordnance of the Navy in developing superior ordnance matériel.

He was always a firm believer in the important rôle of the small independent company in ordnance development. This was well demonstrated in the article, "Fifty Years of Arms Development" by Dr. John J. O'Connor, published in the September-October 1952 issue of ORDNANCE, in which the achievements of Mr. Leech's small but efficient company were chronicled.

Among the many pioneering advances sponsored by Mr. Leech were the first breechblock with eccentric firing pin; the first single-handle rotating breech mechanism; the Hadfield cast-steel armor-piercing projectiles; the Benét-Mercié air-cooled machine gun; the 60-mm. and 81-mm. trench mortars; the shaped-charge principle for armor penetration; Energa and HEAT rifle grenades; and Blindicide rockets and launchers.

Mr. Leech was also widely known in tennis circles. He was a former treasurer of the United States Lawn Tennis Association and was the donor of the Leech tennis trophy for competition among Army, Navy, and Air Force teams.

He was a founder of the Washington Post of the Ordnance Association in 1925.

His passing was deeply mourned by his host of friends, military and civilian alike, throughout the Defense establishment where his ability and integrity were highly valued since the turn of the century.

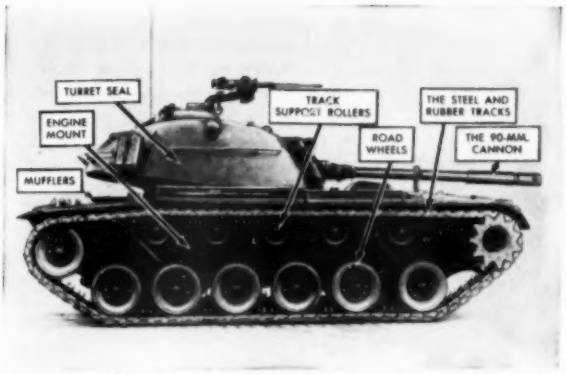
• **BEN HUGHES**, former president of the Nebraska Post of the American Ordnance Association, died recently at his home in Seward, Nebr.

He was born in Seward and studied architecture and structural steel at the Chicago Technical College. His first business enterprise was a small woodworking plant. In the course of his travels he discovered that there was much faulty transmission-line construction all over America, and he coöperated with his brothers in founding a company in 1921 to remedy this condition.

He was president of the Better Nebraska Association and was very much interested in improving the State highway system and in bringing additional industry into Nebraska. He took a leading part in the Ordnance program in Nebraska during the Second World War and maintained that interest in subsequent years as president of the Nebraska Post.

Firestone

WORKS WITH ORDNANCE FOR NATIONAL DEFENSE

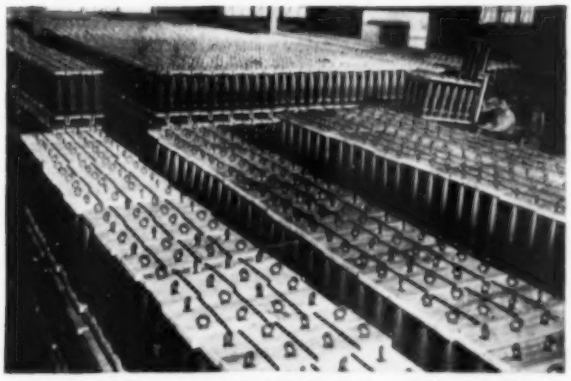


Now in production at Firestone are many steel and rubber products for tanks, including 90-mm. cannon, tracks, road wheels, support rollers, mufflers, turret seals and engine mounts.

FOR a long time to come, American industry will face the two-fold task of producing plentiful quantities of civilian goods to protect the economy of the nation, and at the same time, providing the armed forces with everything necessary to protect our country against its enemies. Firestone is doing both jobs right now!

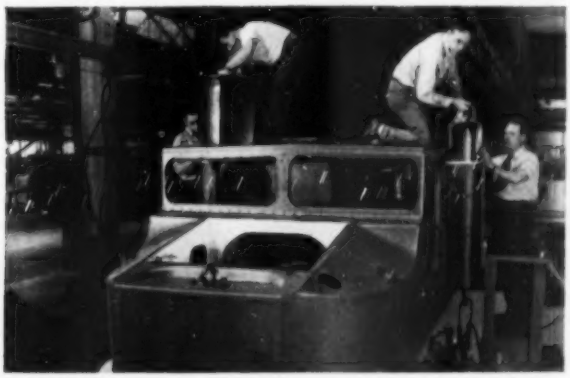
Ever since World War I, Firestone has been a principal supplier of the Ordnance Department, turning out not only products made of rubber, but also products made of metals, plastics and fabrics. Through close association and long experience, Ordnance has learned that Firestone delivers the goods . . . on time, equaling or exceeding specifications, and at low cost.

Firestone is turning out large quantities of tires, tubes and brake lining for all types of wheeled vehicles for the armed services, and providing them with spark plug equipment.



Ordnance has contracted with Firestone for the manufacture of 155-mm. artillery shells. Firestone also operates for the Government a large arsenal at Ravenna, Ohio.

The recoilless rifle has become one of the most effective weapons in the field. Firestone is now in quantity production on both the 75-mm. and the 57-mm. recoilless rifles.



Fuel cells for many widely different applications are being manufactured in the Firestone factories, including fuel cells for motor vehicles such as the Otter, shown above.

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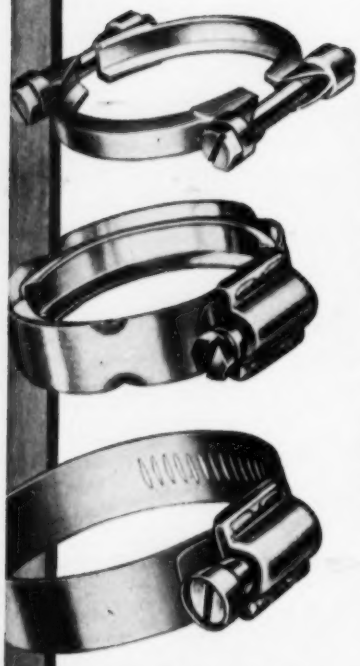
HOT UNDER THE COLLAR . . .

But This Special Purpose [redacted] Clamp WON'T BLOW its TOP!

- Heavy corrugated band for extra strength.
- Heavy stainless steel welded lugs.
- Hex nut for high torque tightening.
- Bolt safety-fastened—can't get loose.



Special Purpose Clamps by Breeze.

A jet engine exhaust is a volcano of heat, pressure and vibration. The clamp that goes around it must withstand these conditions—and *hold tight.*

Breeze makes a clamp for this exacting use, and for a wide variety of other applications where stock items just won't do.

Just as Breeze AERO-SEAL hose clamps have set higher quality standards in their class, so Breeze fabricated-to-order clamps have the extra strength and other properties for every special use. Any design, any metal, any quantity. Tell us your clamping problems.

OTHER BREEZE PRODUCTS
Flexible Metal Tubing and Conduit, Aircraft Actuating Systems, Special Drives and Gear Boxes, Special Electrical Connectors, Metal Bellows, Ignition Shielding.

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NEW DEVELOPMENTS

NAVY GUIDED MISSILE

The Navy has announced that it now has in operation a submarine carrying a faster-than-sound guided missile capable of blasting inland targets. The Navy now can move a submarine up to an enemy coast, launch its missile, and guide it to a distant target. The guided missile—called "Regulus"—looks and apparently operates like a small, pilotless, sweptwing jet fighter plane. The body of the missile is about thirty feet long, but the pattern will vary according to the type of job the missile is designed to do.

NEW HYDRAZINE PLANT

The first large-scale plant in the United States to produce hydrazine, the chemical brought out of obscurity by the Germans during World War II for use as a rocket fuel, was recently completed by Mathieson Chemical Corporation. The new plant is located at Lake Charles, La., and will produce hydrazine both for military purposes and for use in a wide range of promising new industrial applications, including life-saving drugs, insecticides, soldering fluxes, plant-growth retardants, plastics, synthetic fibers, and foam rubber.

INFANTRY TEAMS

A number of Infantry riflemen replacements being assigned overseas will be shipped from the United States in 4-man teams. Eventually, it is expected that all enlisted Infantry replacements will be moved overseas in this manner. The Army said that men who remain throughout the replacement system with other soldiers with whom they have received basic training maintain a higher *esprit de corps* and become more readily adjusted to their duties in their first overseas assignment. Under the program, eligible personnel with the same military occupational specialties will be formed into 4-man teams during the twelfth week of their basic training and will complete the remaining four weeks of the 16-week training cycle in these groups.

THE NEW SABRE

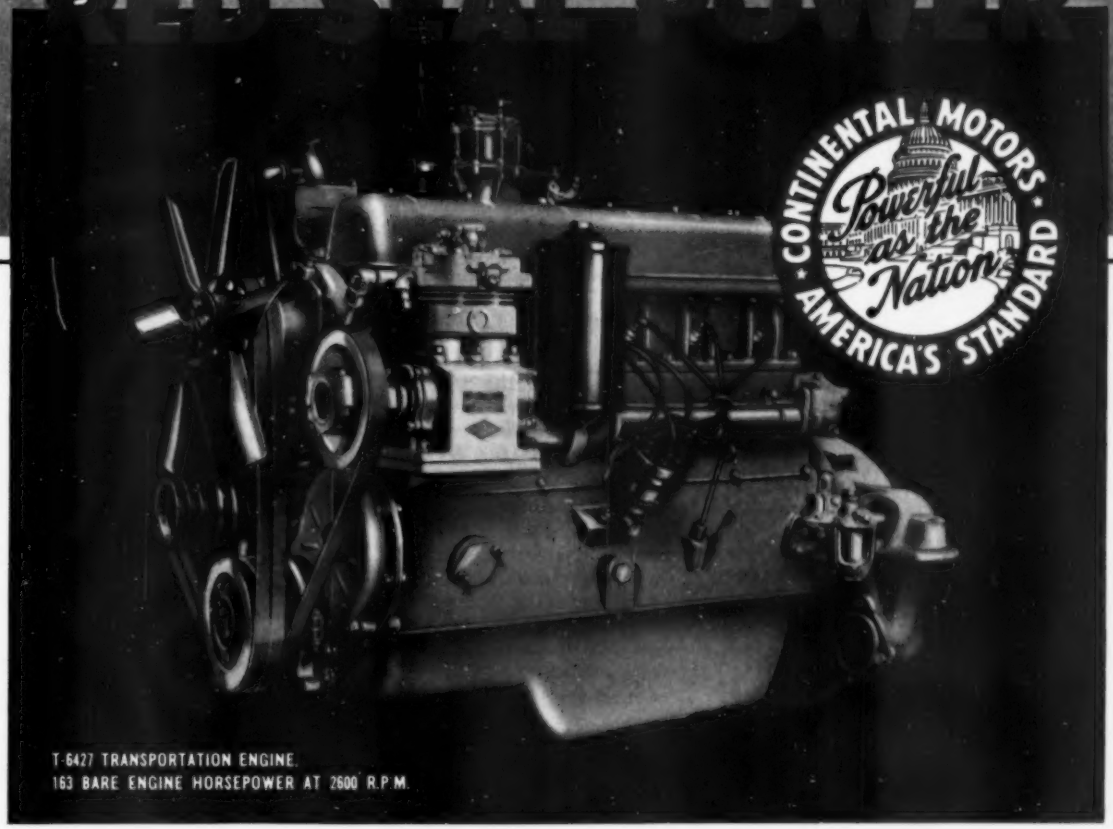
A new and more powerful Sabre jet fighter—the F-86H—is a completely new airplane designed to carry out dual missions as a fighter-bomber and a day fighter. Slightly larger than current Sabres, the "H" is the fifth and latest in the Sabre series. It is powered by a J-73 jet engine, which incorporates many advances in design engineering with considerably more thrust, yet has the same frame size as the older models. The new

Engineered to Out-Perform

...and BUILT TO LAST

· CONTINENTAL ·

RED SEAL POWER



T-6427 TRANSPORTATION ENGINE.
163 BARE ENGINE HORSEPOWER AT 2600 R.P.M.

For more than 50 years, Continental has been engineering power plants to do more useful work per pound of engine weight, and building them to run longer with less time out for repairs. Materials flow more steadily and at lower ton-mile cost, when they move to the job in trucks with dependable Red Seal power. And the range of the Red Seal line—28 basic models, Diesel and gasoline—assures exactly the right engine for every commercial transport job.

Continental Motors Corporation

MUSKEGON, MICHIGAN

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918 S. BOSTON ST., ROOM 1008, TULSA, OKLA. • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

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. . . CUSTOM ENGINEERED DESIGNED AND BUILT TO MEET JOB REQUIREMENTS

. . . high-temperatures readily available with high-efficiency operation, low-maintenance and simplified installation and controls . . .

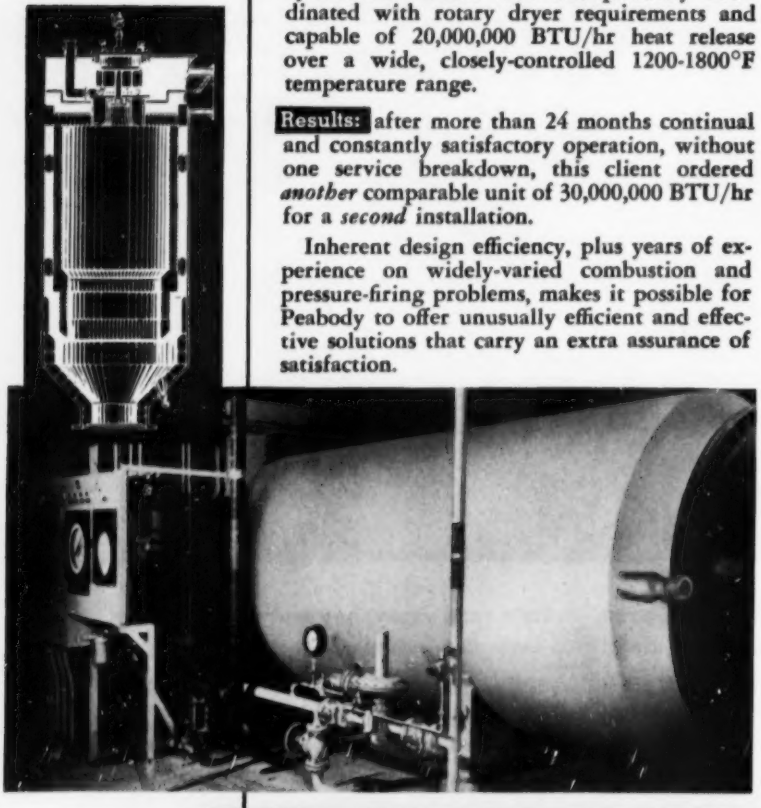
Peabody Cylindrical Furnaces are successfully solving many critical processing problems throughout industry with major benefits of reduced costs and increased product quality.

Typical Problem: to thoroughly dry, with hot combustion gases, various bulk chemicals in a rotary dryer so effectively that customer acceptance and purity of end product would be assured.

Solution: Peabody engineers designed and built a cylindrical, direct-fired, gas/oil-fired cylindrical furnace that was perfectly coordinated with rotary dryer requirements and capable of 20,000,000 BTU/hr heat release over a wide, closely-controlled 1200-1800°F temperature range.

Results: after more than 24 months continual and constantly satisfactory operation, without one service breakdown, this client ordered *another* comparable unit of 30,000,000 BTU/hr for a *second* installation.

Inherent design efficiency, plus years of experience on widely-varied combustion and pressure-firing problems, makes it possible for Peabody to offer unusually efficient and effective solutions that carry an extra assurance of satisfaction.



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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 36, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers

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255

New Developments

Sabre has a clamshell type canopy, a sturdier landing gear, and improved suspension and release mechanisms for carrying droppable wing tanks in conjunction with bombs and rockets for its fighter-bomber rôle. It also carries six caliber .50 machine guns.

SUPERFAST MISSILES

Government research scientists have disclosed that they are working on guided missiles which may attain speeds up to 15,000 miles an hour, or almost 20 times the speed of sound. They also disclosed that rocket-powered models of tactical airplanes and missiles already are being flown at speeds of more than 3,000 miles an hour.

MIGHTY MITE

The Marines are experimenting with a midget-size vehicle—the Mighty Mite—that may solve some of the toughest transport problems of modern warfare. The Mighty Mite weighs only 1,500 pounds, is only 100 inches long, and has a 64-inch wheel base. Its tiny 44-horsepower engine is air-cooled and is easy to service. Under the stubby hood are crowded the accessories—all high enough so the midget can go through fifty inches of water. The secret of the vehicle's mobility is a new type of suspension which makes each wheel drive independently of the other three. Most of the joints are permanently lubricated, to reduce maintenance problems.

LANDINGS SPEEDED

An electronic system for airport traffic control which greatly increases the landing rate of aircraft under high-density traffic or poor visibility conditions has been developed by B. F. Greene, Jr., of the Air Force Cambridge Research Center, Cambridge, Mass. The new system utilizes radar to track and automatically schedule the landing sequence of aircraft approaching an airport. The equipment is so designed that it first calculates the time at which a given aircraft would arrive and then determines if another aircraft has been previously scheduled for that time.

If the runway is found to be free of other landing aircraft, the aircraft comes directly in. If, on the other hand, a landing has been scheduled, the system then finds the next available open time and computes a detour path that will introduce the proper delay. The computed heading instructions are relayed by radio to the pilot.

This system eliminates the delays inherent in the presently used method of "stacking" and permits landings at 30-second intervals providing that other

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more and more service shipments
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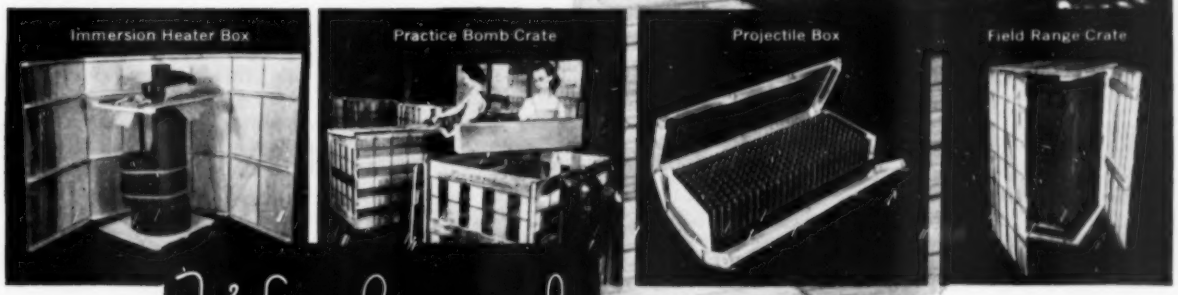
An ever increasing number of suppliers are taking advantage of improved Military and Federal specifications so that they may obtain the benefits of Wirebound containers for Armed Service shipments. They've found Wirebound box manufacturers well qualified to supply containers that meet government requirements for parts, equipment, over-packs, food and hundreds of other uses. Wirebound plants throughout the country are up-to-date on Armed Service shipping specifications and have the experience, technical know-how and testing facilities to produce the best container for each use. Why not check with your Wirebound supplier or write for full information!

Wirebound Box Manufacturers Association
Room 1163, 327 South LaSalle Street, Chicago 4, Illinois



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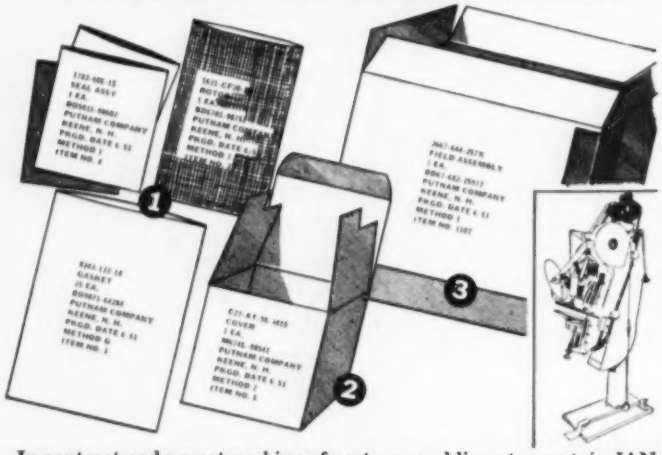
FOR CONTRACT AND OVERSEAS PACKING



In contract and export packing of parts, assemblies, etc., certain JAN specifications call for three packaging stages: (1) enclosure in scrimback or polyethylene lined *heat sealing* envelope, (2) intermediate packing in a folding box, (3) final packing in corrugated carton. Each of these three types of containers must be marked for instant and *permanent* identification. Many manufacturers, dissatisfied with conventional marking with crayon, stencil, labeling or other form of hand stamping, have not only found great savings in time and money, but also obtained more legible, longer lasting identification using a Markem Method. *One* Markem machine (with appropriate Markem type and Markem ink) prints desired information on *all three* containers. The vapor barrier of the envelope is not broken. Desired information is changed rapidly. By printing quantities of containers as and when needed, inventory problems are minimized. In this way, the Markem Method insures *positive identification* when the items reach their destination.

MARKEM MARKS THEM ALL

CAN MARKEM HELP YOU? Identification printing for contract and overseas packaging is but an example of how Markem solves industry's marking problems. Markem has been providing industry with production techniques and equipment to identify, decorate or designate its products, parts and packages since 1911. Markem also provides technically trained men who are available in your area to assure *continued* satisfaction with Markem methods and equipment.

When *you* have a marking problem, tell us about it and send a sample of the item to be marked. Perhaps a complete Markem Method has already been developed to solve your problem. If not, Markem will work out a practical solution.

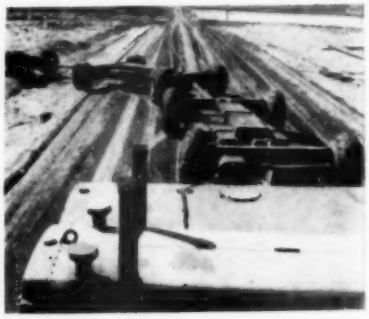
Markem Machine Company, Keene 9, N. H., U. S. A.

MARKEM ...TO MAKE YOUR MARK

factors, such as clearing aircraft from the runway, will so allow.

RUBBER-TIRED TRAIN

R. G. LeTourneau, equipment inventor, has unveiled the Tournatrain—a rubber-tired locomotive and freight-car combination capable of economic operation over pathless desert sands or a cheaply constructed road through jungles.



Cars follow locomotive around corner.

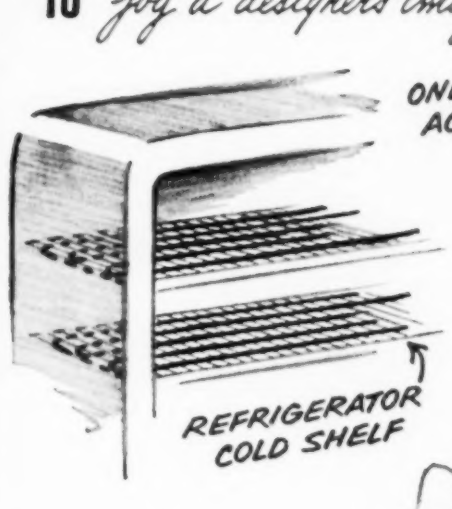
The heart of the Tournatrian is the "electric wheel," which carries a large pneumatic tire and has within its rim an electric motor and gear reduction. The electric wheels derive their energy from the locomotive which mounts Diesel-driven electric generators. There are no brake shoes to wear out because the same electricity that drives the wheel can be used to hold it back going down hill. Only an automatic spring-loaded brake is provided for emergency.

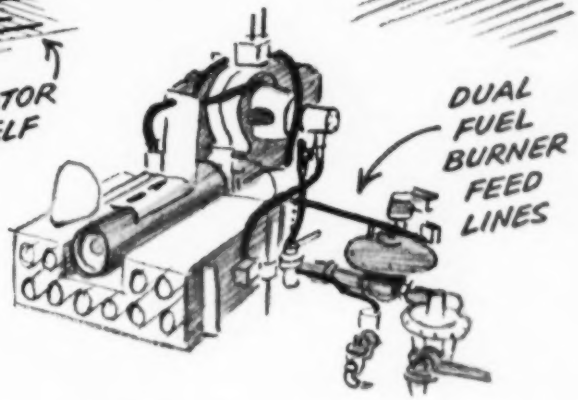
Each car is coupled to the car ahead of it in such a way that it follows in the same tracks. By a simple automatic steering device the path of the locomotive is duplicated in its turn by each car of the train so that the locomotive can pull up to a street intersection and make a right-angle turn and every car will come up to the same spot and make the same turn.

NEW LIGHT SOURCE

A new device for providing an intense continuous light source for taking night aërial photographs is being developed for the United States Air Force by a group of scientists and engineers at Wesleyan University, Middletown, Conn., under the auspices of the Air Research and Development Command. Called the "Hell Roarer," the device enables the taking of night aërial photographs by means of special cameras. The mechanism, contained in a torpedolike 12-foot cylinder, attaches to the wing of a reconnaissance aircraft and is controlled by the pilot. The fuel for the Hell Roarer is finely pulverized magnesium powder which burns at an extremely high temperature and

FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*





REMARKS Give your ideas a cost-saving twist -- with Bundyweld Tubing. The very standard of dependability, it's helped beat many design, fabrication problems. Add: Bundy's unmatched fabricating, specialized engineering.

WRITE → today for Bundyweld catalog or for help in developing your tubing application ideas.

BUNDY TUBING COMPANY, DETROIT 14, MICH.

Bundyweld Tubing

® DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

Lightweight
Machines easily
Takes plastic coating
Scale-free
Bright and clean
No inside bead
Uniform I.D., O.D.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness, and passed through a furnace. Copper coating fuses with steel. Result . . . Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave. South ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., E. • **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**

whatever you need
you'll cut costs using

BUSCHMAN
CONVEYORS

A recent single order of BUSCHMAN Conveyors filled sixteen freight cars . . . almost *fifteen miles* of roller conveyor sections. The small business needing only a ten-foot section to span from loading dock to truck also looks to BUSCHMAN to supply its needs.

Whether your requirements are large or small, BUSCHMAN low-cost, rugged, light weight roller conveyors represent the easiest, most economical way to safely and quickly move packaged or self-contained products through any one or all phases of plant operations.

PRODUCE MORE . . . FOR LESS
on
Buschman
Conveyors

Write For Bulletin No. 60

THE E. W. BUSCHMAN CO.
4478 Clifton Ave. Cincinnati 32, Ohio

Representatives in principal cities.

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James A. McKechnie, Ltd. Toronto 13, Canada.

must be handled with great care. It puts out an intense light of approximately 10,000,000 candlepower.

NEW TITANIUM PROCESS

The Mallory-Sharon Titanium Corporation, of Niles, Ohio, recently announced the development of a new melting process which produces ingots with characteristics said to be superior to anything presently known and in addition increases the yield of metallic titanium from its sponge raw material, now in critical short supply. The advantages of the new melting process, designated Method S, are: (1) Ingots are homogeneous and display the same characteristics throughout. Thus there are no variations in a sheet, for example, rolled from a single ingot. Ingots of a given type are reproducible, and the size and shape can be varied over a wide range. (2) Carbon content can be controlled exactly to any amount specified and held as low as the amount inherent in the sponge material. A titanium electrode is used in place of a carbon electrode, and the melting is accomplished in a crucible made of copper, which is water-cooled. (3) The yield is increased markedly, and more metallic titanium can be produced from a given amount of sponge raw material since scrap loss is reduced.

ORDNANCE TEST EQUIPMENT

Recently completed shock and acceleration-simulation devices, including a 91-foot drop tower, air guns, a wind tunnel, and centrifuges, are providing improved facilities for the ordnance-development activities of the National Bureau of Standards. The new equipment is used primarily to study the effects of high accelerations—similar to those to which ordnance projectiles are actually subjected in normal use—on experimental ordnance components.

The Bureau's Air Gun Building includes two air guns, one of them 96 feet long; a wind tunnel, used in related work, with a velocity of 300 feet a second; and 4 centrifuges, one of which can produce accelerations of 60,000 g (g representing the acceleration of gravity) on 1-pound specimens. The drop tower, located near the Air Gun Building, is used for studying the effects of various shock impacts.

The Bureau's ordnance testing functions are now being transferred to the Ordnance Corps of the Army (see p. 252).

ANTISUBMARINE WEAPON

The United States is evaluating for possible adoption a British multibarreled antisubmarine mortar able to detect, locate, aim, and fire underwater bombs in a single automatic operation. It is reputed to be able to crack the hull of the toughtest submarine yet made. Another

"Whether we want it or not, the responsibility for the perpetuation of democracy . . . is squarely on our shoulders, and unless we maintain the strength to defend all liberty we are certain to lose our own."

—ADMIRAL ARTHUR W. RADFORD

Nowhere is democracy stronger or more deep-rooted than in America . . . for only in America have the people had the freedom, the initiative and the self-reliance to make democracy work. Maintaining the strength of our democracy, then, is largely a matter of preserving the freedom which is the source of that strength. *Only with a healthy, dynamic, free enterprise economy can we remain strong enough to keep freedom alive in the world.*

W. B. Stuart President

DUTY HONOR COUNTRY
LABOR BUSINESS GOVERNMENT

The Gray Manufacturing Company, Hartford 1, Connecticut

Makers of Audograph and PhonAudograph Electronic Soundwriters

AND GRAY RESEARCH AND DEVELOPMENT CO., INC., Specialists in Video, Audio, Sub-Audio Electronic Mechanisms

Specializing in ORDNANCE PRODUCTION

FOR THREE WARS we have supplied the U. S. Government and prime contractors with fine instrument screws and components for military equipment . . . Waltham Screw Company is recognized as a leading producer of ammunition components, fuze parts, small arms parts, and special contract parts . . . Made exactly to Government specifications . . .

Single and multiple spindle screw machines, roll threading, centerless grinding, all secondary operations, plus heat treating finishes. Machining all metals. Maximum capacity 1⅛" round.

MEMBER OF NATIONAL SCREW MACHINE PRODUCTS ASSOCIATION

Specialists in Screw Machine Products Since 1893

WALTHAM SCREW COMPANY

78 Rumford Avenue, Waltham, Massachusetts

New Developments

British invention now being tested by the U.S. Navy is a midget submarine, fifty-three feet long, with a crew of five.

PLASTIC PIPING

A test installation of reënforced plastic piping, which has been in service in a destroyer-escort class vessel for more than twenty months, has been found to resist shock and salt-water corrosion. To test for shock, a section of the pipe carrying salt water under ninety p.s.i. pressure was installed just aft of the forward gun mount. The section remained unaffected while steel pipes in the vicinity failed due to the combined effect of shock and corrosion.

Plastic pipe is said to offer the following advantages over metal pipe: It eliminates need for replacement caused by corrosion, is lighter in weight, may be readily repaired without welding, and is expected to become cheaper than corrosion-resistant metallic piping. Disadvantages include limited resistance to heat and fire, susceptibility to marine fouling, and difficulty in forming and bending.

BALL POWDER PLANT

The Office of the Secretary of Defense has authorized the construction of a Government-owned plant at the Badger Ordnance Works, Baraboo, Wis., to produce ball power—a smokeless powder developed by Olin Industries, Inc., for sporting and military ammunition. It was used for military small-arms cartridges in World War II and is being used in the present defense program. Ball powder is a spherically grained smokeless powder produced by a revolutionary chemical process several times faster than powder made by conventional methods. With most of the manufacturing processes conducted under water, Olin ball powder is said to be safer to produce than any other.

CUSHIONING MATERIAL

The serviceability of bonded shredded cellular rubber cushioning has been revealed by recent tests at the New York Naval Shipyard with the development of a new material primarily derived from latex foam and scrap. The material is the result of a process of grinding selected odd and normal scrap materials from straight latex foam manufacturers. Coated with rubber binding and cured in molds to the desired shape and density, the material has the same resiliency and odorless properties of straight latex foam.

HEAT-SENSITIVE CABLE

A newly developed heat-sensitive cable, only seven hundredths of an inch in diameter, has proved itself highly effective in minimizing aircraft fire hazards under flying conditions. The cable's effectiveness

Suppose we put the Dempster-Dumpster System right down in your plant . . . then what?

● *Well First—let's make it clear that we are furnishing you with several sizes of different designs of 26 containers to suit your materials requirements. Then bear in mind that we are delivering you only one truck-mounted Dempster-Dumpster and with your driver this one outfit picks-up, hauls and dumps all containers, about like the one shown above.*

Now, how many conventional trucks are you using for handling rubbish, scrap, raw materials, and what have you?

For several years now, one plant has been doing considerably more work with two Dempster-Dumpsters and two men than they did with five trucks and fifteen men before the Dempster-Dumpster System was installed. You can guess at the approximate savings annually.

A glance at the picture below and you get the whole story of the Dempster-Dumpster System. Never before have you been able to cut bulk materials handling costs so drastically.

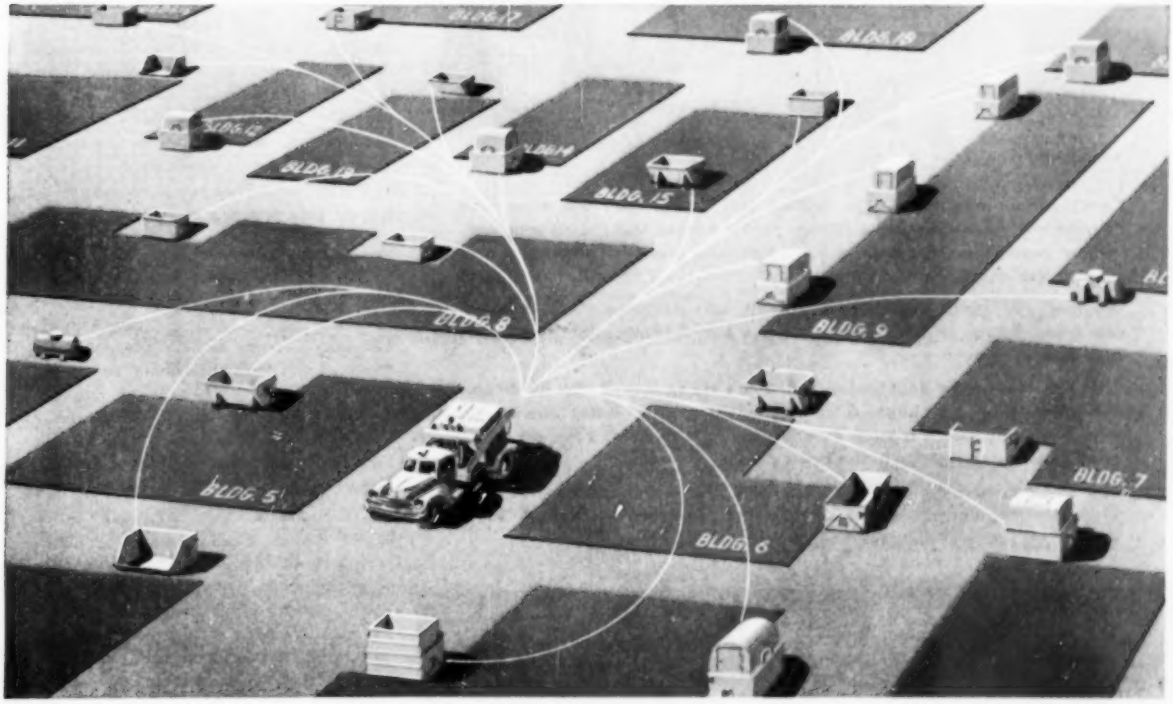
One truck mounted Dempster-Dumpster handles the entire group of 26 Dempster-Dumpster containers. These big, detachable steel containers are like having 26 truck bodies for a single truck.

Any required number of Dempster-Dumpster containers are spotted at convenient materials accumulation points inside and outside your buildings. They range in sizes up to 12 cu. yds.—3 to 4 times the capacity of a regular dump truck. Materials—bulky, light, heavy, solids, rubbish and even liquids—are dumped or placed into these containers.

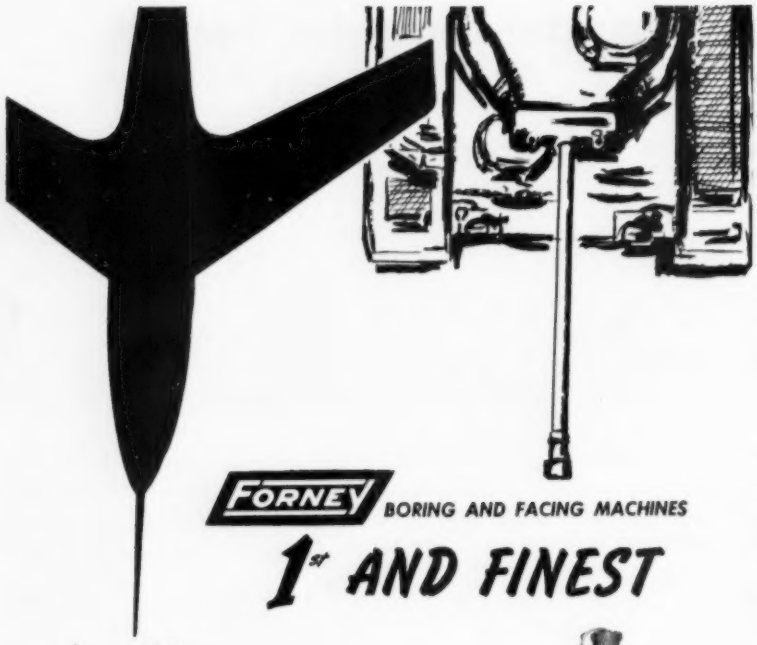
The truck mounted Dempster-Dumpster makes scheduled rounds, picks up each preloaded container, carries it to the point of disposal, sets it down intact or dumps the materials and returns the container for refilling. The entire operation is hydraulically controlled and handled by your truck driver.

It's as simple as we have described it. The amazing thing is the tremendous savings being made by the Dempster-Dumpster System in hundreds of leading industrial plants over the nation.

A product of Dempster Brothers, Inc.

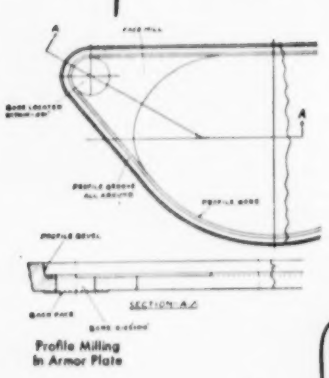


DEMPSTER BROTHERS, 993 Shea Building, Knoxville 17, Tennessee

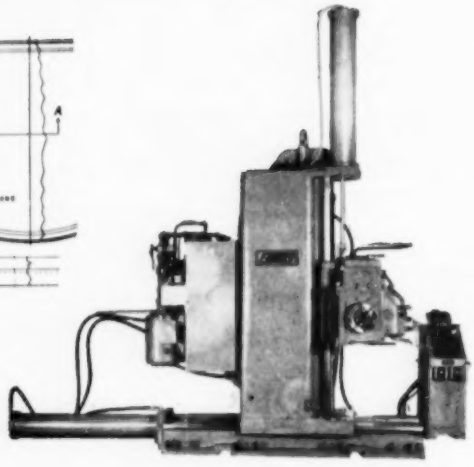


FORNEY BORING AND FACING MACHINES

1st AND FINEST



Profile Milling In Armor Plate



—Unretouched Photograph

Complicated, irregular profile milling and boring jobs are easy and economical when done by a Forney profile boring and facing machine. Forney machines are specially engineered for work on aluminum and magnesium castings and forgings.

Whether you make parts for the highly specialized aircraft industry, armored vehicles or other technical fields you will make them better for less with a Forney.

These custom made, double-duty machines are equipped with duplicator equipment with templates. A spindle housing as a motor power unit moves directly into the work face. This results in more accurate work, more power and rigidity in the cutting tool.

Top quality work holding fixtures tooling and floor plates are also available. Write or phone us today. Forney engineers are ready to serve you immediately upon receipt of your drawings.

FORNEY'S INC.

Manufacturers of Special Machinery Since 1916

211 ELM STREET NEW CASTLE, PENNA.

New Developments

was revealed in preliminary reports of exacting fire tests conducted by the U. S. Air Force's Air Research and Development Command and the Civil Aëronautics Administration. The most recent tests of the cable, developed through research by staff scientists at Edison Laboratory, Thomas A. Edison, Inc., West Orange, N. J., were made at the CAA's Technical Development and Evaluation Center at Indianapolis.

NEW RANGE FINDER

New, more accurate optical range finders and ballistic computers—"eyes" of the U. S. Army's new Patton 48 tanks—are now in production at Northrop Aircraft's Anaheim Division. The latest range finder has significant advantages, chiefly higher speed and greater accuracy, over previous models.

PLASTIC SPRAY COATING

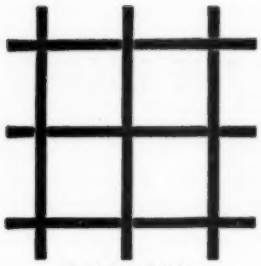
A new method of protecting military tanks and other vehicles going into overseas shipment and storage is now being used by the Air Force and Army using material conforming to Specification MIL-B-12121. A sprayable plastic coating of the "cocoon" type is applied to seal off and waterproof parts and areas where tape and paper were formerly used.

"The new process is said to eliminate taping, framing, and other expensive packing methods and to save many hours of the processor's time. It has been reported that the storage life of tires is doubled when protected by the plastic coating. The coating is not removed from tires or seats when a vehicle is put in use. The plastic can be easily removed by stripping, but in these two instances it becomes a permanent coating.

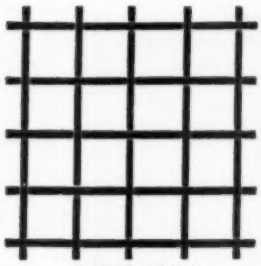
NEW PILOT HELMET

A new slotted helmet has been designed to protect pilots forced to bail out from their aircraft while traveling at supersonic speeds. Engineers of the Douglas Aircraft Company's Santa Monica Division, who designed and built the helmet, report the slots or vents which are cut into the forward crown section of the headgear greatly reduce wind shock and air lift and keep the helmet secure to the pilot's head.

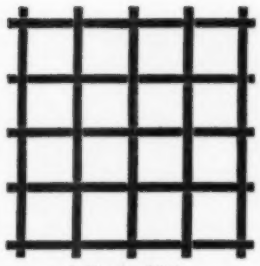
The helmet has been successfully tested in an outdoor wind tunnel at simulated speeds up to Mach 1.04. At such speeds, approaching and exceeding the speed of sound, standard-type helmets tend to be blown off. This would leave the escaping pilot without protection from supersonic wind blasts and—since the oxygen supply is attached to the helmet—without oxygen.



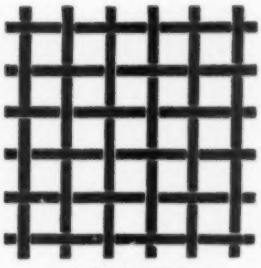
2 Mesh .063"
76.4% Open Area



3 Mesh .041"
76.7% Open Area

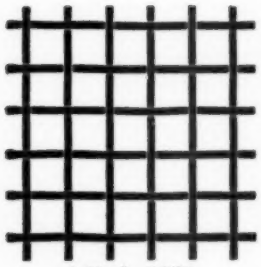


3 Mesh .054"
70.1% Open Area

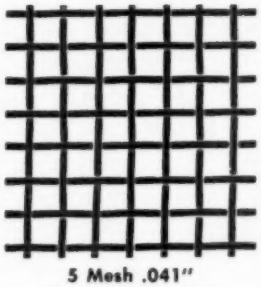


4 Mesh .063"
56.0% Open Area

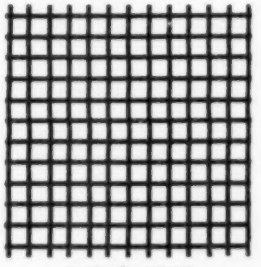
CALL CHASE



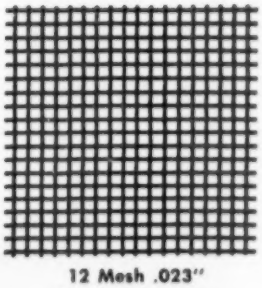
4 Mesh .047"
65.9% Open Area



5 Mesh .041"
63.2% Open Area

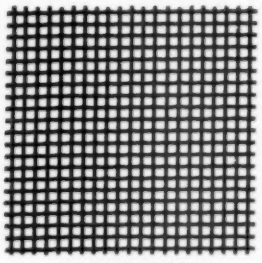


8 Mesh .028"
60.2% Open Area

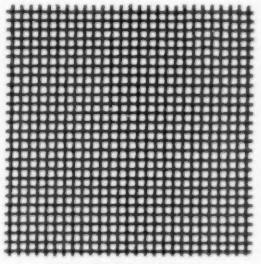


12 Mesh .023"
51.8% Open Area

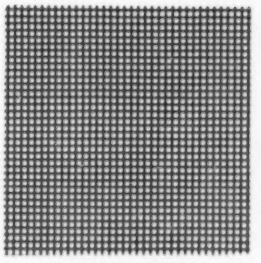
FOR INDUSTRIAL WIRE CLOTH



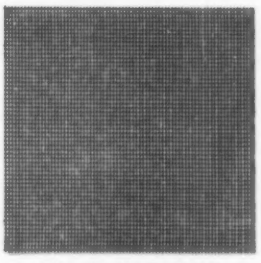
14 Mesh .020"
51.0% Open Area



18 Mesh .017"
48.3% Open Area



24 Mesh .0135"
45.8% Open Area



50 x 40 Mesh .009"
35.7% Open Area

IN BRASS AND COPPER

From coarse wire cloth for window or door grilles . . . right down to extra-fine mesh for food preparation, call Chase.

Double crimped wires of Chase Wire Cloth keep openings square and true . . . mesh uniform. It is woven in a mill which specializes in weaving brass, copper and copper-alloy wire cloth. The result is *quality*.

For information on the size and type wire cloth *you* need, send for free book or call your nearest Chase warehouse.

Chase®

BRASS & COPPER

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The Nation's Headquarters for Brass & Copper

Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
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Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

. . . HAVE ADVANTAGES IF YOU ARE PRODUCING MILITARY SPARE PARTS OR SUPPLIES.

MIL-C-12147(A) MIL-C-5405 DAPD-P-154

The advantages to you include lower packaging costs in that less labor is required on the assembly line and, in most instances, increased output results. Closing equipment is available on a rental basis.

The advantages to the military include a continuous barrier for each completed package. This offers maximum protection against mechanical failure in service handling, and with a minimum of error due to the human element in packaging operations.

Spare parts and supplies packaged in cans made under MIL-C-12147(A), MIL-C-5405 and DAPD-P-154 meet all the requirements of Method 1A and Method 1C, Unit Packaging, under MIL-P-116A. This packaging is approved and currently in active use by most of the technical branches of the service.

In addition, there is a growing acceptance for the use of these containers in many civilian applications.

Write or call us regarding any packaging problems confronting you at this time. We will provide the technical help.

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO
• All-Fibre Cans • Combination Metal and Paper Cans
• Spirally Wound Tubes and Cores for all Purposes

PLANTS AND SALES OFFICES: Cleveland, Detroit, Chicago, Plymouth, Wisc., Jamesburg, N. J., Ogdensburg, N. Y. • ABRASIVE DIVISION at Cleveland
SALES OFFICES: Grand Central Terminal Bldg., New York City; Washington Gas Light Bldg., Washington, D. C.; West Hartford, Conn.; Rochester, N. Y.
Cleveland Container Canada, Ltd., Prescott, Ontario • Offices in Toronto and Montreal

FROM THE RECORD

CONTROL OF THE SEA

ROBERT B. ANDERSON
Secretary of the Navy

The pattern of political and geologic accidents that presented us with the sinews of a great nation have now, in the Atomic Age, come to be a source of grave concern.

I suggest you take a map of the United States sometime and look at it carefully, and think seriously about the things you see there. Look at New York, knowing that some 8,000,000 people are jammed into its 321 square miles, that it handles a fourth of our ocean-going commerce, and that the value of its manufacturers exceed those of Detroit, Boston, Pittsburgh, and Cleveland combined.

In northern Minnesota, just west of Duluth, you will find the Lake Superior ore district, where seventy per cent of our iron ore is mined. Between Lake Superior and Lake Huron you will find the Soo Canal, the needle's eye through which nearly all the ore passes on its way to the Chicago and Pittsburgh-Youngstown areas, where sixty per cent of the Nation's steel is produced.

In and around Detroit, half a million people make fifty per cent of the country's automobiles. No less than twenty through railroad lines run into and out of Chicago.

Targets Concentrated

And within the narrow band of territory extending inward for one hundred miles from our frontiers, you will find all but three of our fifteen largest cities. Of these frontiers, some six thousand miles look upon the sea, comparatively vulnerable to attack should an enemy approach from the sea or through the air over the sea. Although not by deliberate design, we have succeeded in placing most of our prime strategic targets in a most vulnerable position for attack by enemy ships, aircraft, or submarines.

These, then, are the factors which our geography and the peculiarities of our industrial civilization have thrown into the balance of our requirements for security: We are separated from friend and foe alike by a vast expanse of blue water; we are halfway round the world from the source of some of our most vital raw materials; we must reckon with the possibility of attack both by sea and by air, and we have disposed our targets so as to favor that attack rather than the defense against it.

Where our security demands that we diversify and disperse, our economy has

ONLY
LURIA ENGINEERING
offers the
ADVANTAGES *of*

STANDARDIZED BUILDINGS

plus all the

adaptability,
flexibility *and*
durability *of*

CUSTOM-BUILT STRUCTURES

Your expansion program need not be a problem. For **high speed** *and* **low cost** *. . . contact your nearest* **LURIA** *representative.*

To achieve utmost *durability of structure*, the materials and construction of Luria Standardized Buildings meet the *most stringent* building code requirements. And because of their *flexibility* and *adaptability of design*, Luria Standardized Buildings make possible almost any type of structure and almost any type of architectural treatment that best suit *your* particular requirements. *This is accomplished without sacrificing the economies of standardization.*

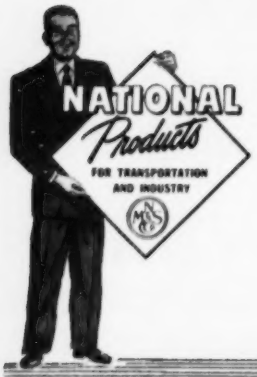
LURIA ENGINEERING COMPANY

500 FIFTH AVENUE • NEW YORK 36, N. Y.

DISTRICT OFFICES:
ATLANTA, GA.
BOSTON, MASS.
CHICAGO, ILL.
PHILADELPHIA, PA.
WASHINGTON, D.C.

Castings by National

selected for Quality and Dependability



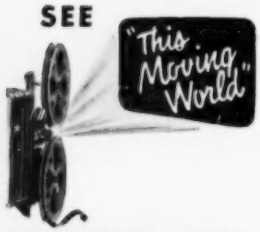
Products bearing these familiar trademarks have all established enviable reputations for quality and dependability. And to guard product reputations, these manufacturers *continue* to specify castings by National —one of the Nation's largest founders.

National's unparalleled experience in producing malleable, heat-treated malleable, and steel castings is at your disposal. Sales offices and engineering facilities are located at all five strategically located plants.

A-5858

PLANTS LOCATED IN Sharon, Pa., Cleveland 6, Ohio, Indianapolis 6, Ind., Melrose Park, Ill., and Chicago 50, Ill.

SEE



A 16mm Technicolor film. Narrated by Edwin C. Hill, this 27-minute film tells how malleable iron is made . . . tested . . . used . . . how its production economy, ductility, machinability, toughness will give you a better finished product. Available for group showings.

NATIONAL Products FOR TRANSPORTATION AND INDUSTRY

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY

CLEVELAND 6, OHIO Est. 1868

demanded that we concentrate and specialize, as indeed we have done, to the point where the destruction of any considerable part of our industrial complex raises serious questions when we contemplate the problems of our production capabilities and our survival.

These factors require that we take a realistic view of the matter of who controls the seas, because it is largely upon that issue that we shall stand or fall in any future conflict. If we can control the seas we can discard the false notion that we are surrounded by the Old World and begin to build our plans and concepts around the fact that it is we who in reality surround it.

Closer to Targets

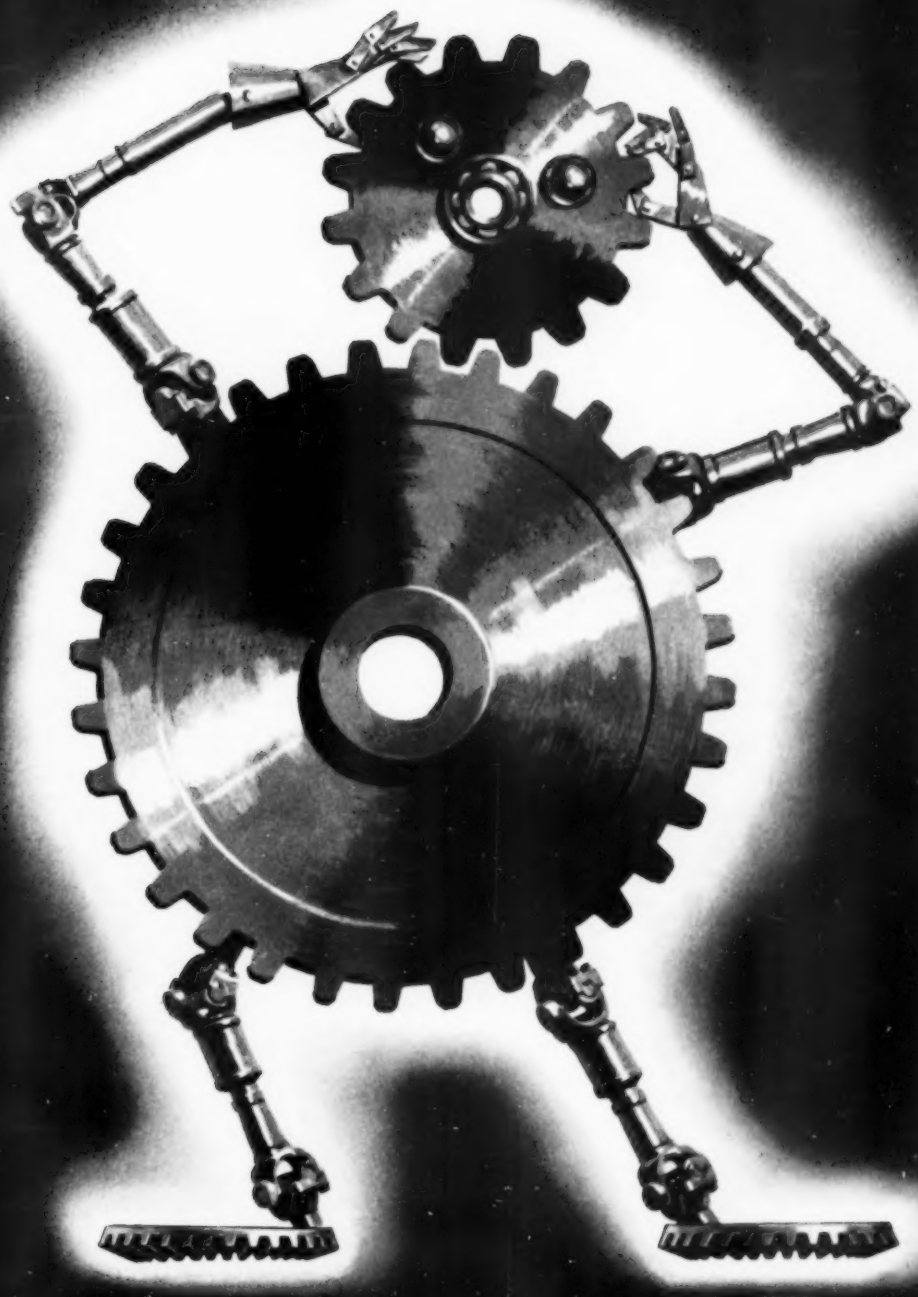
By our possession of that control we shall, in the event of war, be able to place and maintain our attacking forces some three to five thousand miles closer to their objectives in an enemy's territory than the enemy can place his attack forces in relation to their objectives in our territory.

The military import of such an advantage is enormous. It enables us to make war upon the enemy's submarines in their own harbors and in the narrow waters through which they must pass in their transit to and from the open seas. It multiplies the number of strategic bombers and the weight of their deadly pay load which our Air Force can maintain on strike missions over enemy territory by the simple expedient of halving the distance they are required to fly in order to reach their objectives.

We are spared the intolerable burden of maintaining a huge land force at home for no other purpose than to repel an invasion of our shores, and we thus grant our Army the freedom of action it requires to discharge its vital missions overseas. We are permitted the tactical luxury of having fighter squadrons which may be employed with complete flexibility for either offensive or defensive operations. Based upon the edges of our far-flung frontier, they may be used to provide cover for our strategic bombers or as interceptors against the aircraft of an enemy.

Our mobile amphibious troops, in readiness to attack from very short range against a dozen targets, would exert an influence strikingly out of proportion to their numerical strength. Our vulnerable coastal cities, instead of being on the unprotected fringes of our zone of security, may be considered as lying rather close to its center, protected by the gigantic cushion of oceanic space between them and our outer defenses.

Most importantly, our control of the seas means the difference between whether



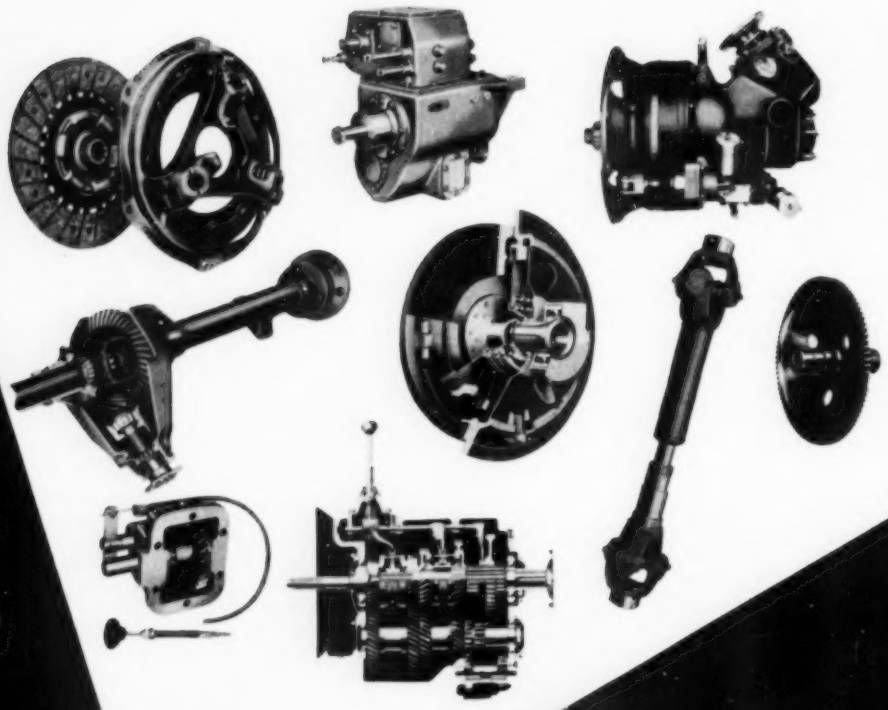
We specialize in making things come out right

Spicer has developed a fine balance between mechanical excellence and human efficiency during the past 50 years. This combination makes things come out right . . . in the plant . . . in the field. It is one of the big reasons why Spicer power transmission units have become the

Standard of the Industry

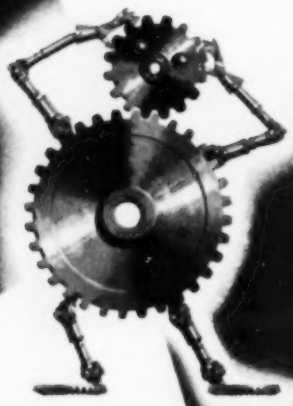
Designing, Developing, Engineering, Manufacturing and Service

Spicer



CORRECT
in the plant

With 10 modern plants doing much of their processing from raw material to finished product . . . with engineering genius and manufacturing skill of the highest order . . . Spicer controls and maintains quality standards acclaimed in the industry.



CORRECT
on the road

Millions and millions of automotive vehicles of every type have proved the correctness of Spicer equipment with billions of service miles throughout the world. Spicer "follow-through" in the plant pays big dividends to the automotive manufacturer and his buyers . . . in performance and prestige.

SPICER MANUFACTURING DIVISION
of Dana Corporation · Toledo 1, Ohio

49 YEARS OF
Spicer
SERVICE

ENGINEERING
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TRANSMISSIONS • UNIVERSAL JOINTS • PROPELLER SHAFTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • WELDED TUBING

When force is gathered in a loop . . .

When force is gathered in a loop
Like a lad rolling a hoop

It has a will and a way
That will not turn astray

And set within a frame
It is by another name

A thing to set man free
From the chains of gravity

And with it he enjoys
An hour of equipoise

Against the wind and tide.
Ah, let him take inside

His topsy-turvy soul
Love's force against the roll

Of anger and of sin
And let the great wheel spin

Until at last he come
To equilibrium.

Gyroscope — from "Stars and Atoms have no size", by A. M. Sullivan (*by permission*).

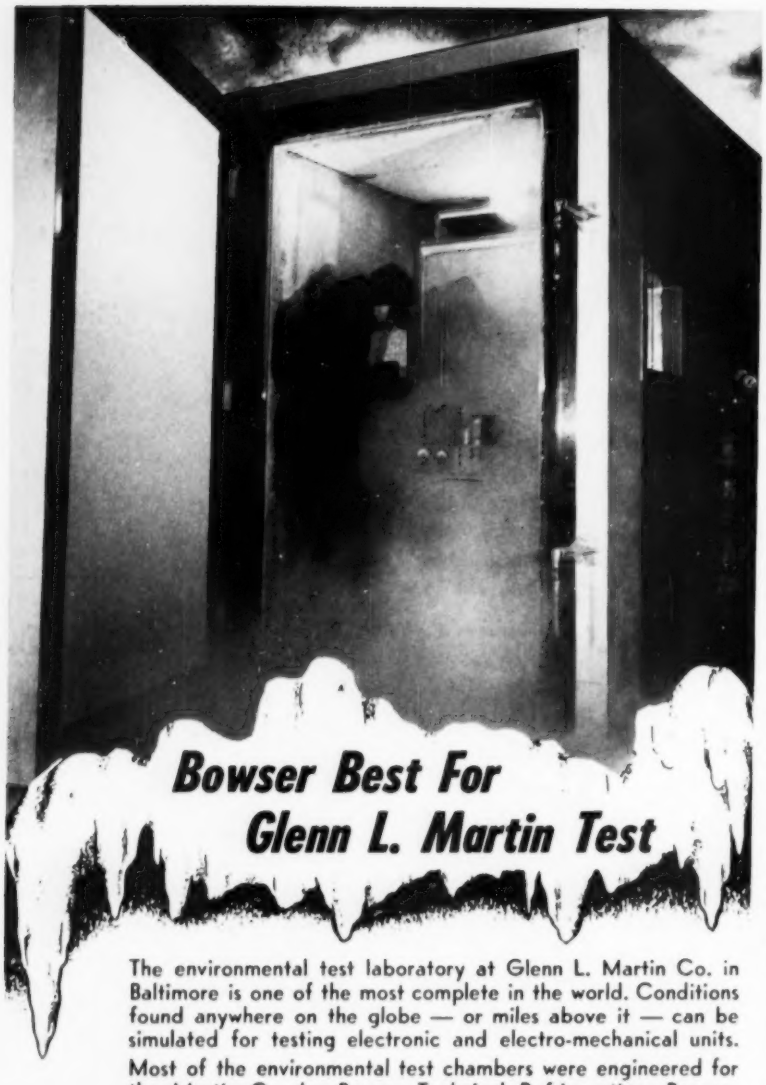
Since 1935, we have specialized in the development and manufacture of systems and components for gunfire and missile control, navigation, bombing, radar, electronic countermeasures, and ammunition and bomb handling.

MAXSON ENGINEERING

—with over 600 engineering personnel, 2500 other employees, and 400,000 feet of laboratory and manufacturing space —augments your own development and production facilities. This highly adaptable organization is fully described in our Third Facilities Report. Write today for your copy.

The W. L. MAXSON CORPORATION

Unimax Switch Division • Langevin Manufacturing Corporation
460 West 34th Street New York 1, New York
Plants at Long Island City, N.Y. and Old Forge, Pennsylvania



Bowser Best For Glenn L. Martin Test

The environmental test laboratory at Glenn L. Martin Co. in Baltimore is one of the most complete in the world. Conditions found anywhere on the globe — or miles above it — can be simulated for testing electronic and electro-mechanical units.

Most of the environmental test chambers were engineered for the Martin Co. by Bowser Technical Refrigeration. Bowser-built units include:

- *Low Temperature Chamber — −100° F can be reached in from 1½ to 2 hours. Snow storms and icing conditions are simulated by forcing in air with a high moisture content.*
- *High Altitude Chamber — up to 100,000 feet, with corresponding temperature drop to −40° F.*
- *Fungus Chamber — temperature and humidity control permit testing with the four types of fungi which most commonly attack components.*
- *Sand and Dust Chamber — 160° F temperature and air velocity variation from 100 to 300 F.P.M. for a 6 hour period determines effects of severest desert conditions.*

Bowser background and engineering experience are available to help you. For all your environmental test needs, be sure to check with Bowser—the pioneer. A Bowser field engineer will be glad to call and discuss YOUR needs—at no obligation.

BTR

BOWSER TECHNICAL REFRIGERATION

DIVISION BOWSER, INC. TERRYVILLE CONNECTICUT

From the Record

we and our allies are separated or joined; whether we fight as isolated, partially effective units or as a team whose total power equivalent is immensely greater than the sum of that of its components.

We of the Navy are determined to maintain for this country the control of the seas during peace or war. This we will do with the weapons at hand today and those we will have tomorrow. . . .

We have the capability of capturing or destroying an enemy's advance bases. We can blockade his coastal waters. We can destroy his air bases from which his planes threaten our sea lanes. We can seek out and destroy his submarines. We can engage in the long necessary hours of search and patrol of convoy escorts and of maintaining radar picket lines. We do these jobs well today and we can and must do them better tomorrow. . . .

Must Control the Air

With the increased development of air power has come recognition of a new and important corollary on the basic concept of sea power; namely, that he who controls the seas must also control the air above the seas. Here again, the Navy is moving down a road of progress and improved capabilities.

That the Navy might control the sea the aircraft carrier was developed. The first airplane to operate from the deck of a United States ship weighed 3,000 pounds and flew at 130 knots. That plane flew from the 534-foot deck of the U.S.S. LANGLEY in 1922. Today's modern airplane weighs 51,000 pounds. It burns many times as much fuel. It flies several times as fast. It carries increased ordnance capabilities. It is better armored to protect its pilots, but it presses new demands upon the carriers.

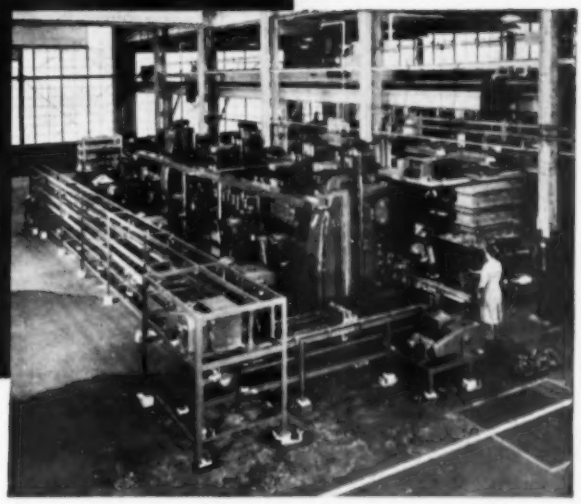
There must be longer runways, greater fuel capacities, intricate repair shops for ordnance and electronic components. It must have greater speed, bigger elevators, more storage space, and a catapult capability of sending America's newest fighting machines into the air.

These new demands we are meeting through the conversion and modernization of ships in our reserve fleet; but even this is not quite enough, for the march of technology, of new speed, new weight, and new fighting capabilities moves relentlessly on. In some tomorrow, conversion and modernization will not be enough, and so we are building new types of aircraft carriers, represented by the FORRESTAL class, to meet the new demands of increased airplane capabilities.

We will use to the utmost and to the full utilization all that we have on hand, but we will be realistic and practical about what we will need tomorrow.—*From an address before the Texas Bar Association, Fort Worth, Tex.*

Ordnance Equipment by W. F. & JOHN BARNES

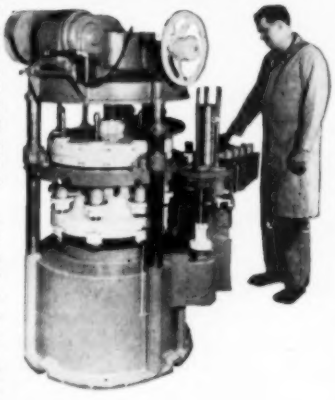
Here are only a few of the pieces of equipment built by W. F. and John Barnes for ordnance. In addition to many other individual pieces we have designed and built an entire plant for the automatic production of 155 mm high explosive shells. Other projects of a similar magnitude are now in progress. We will be glad to work with you on any machining or processing problems pertaining to ordnance.



Fast, Efficient Double Seamer

Here's a new closing machine (double seamer) that features simplicity of adjustment, fast operation and identical seams. Its speed of operation is limited only by slower operating equipment in the line. It has a minimum of parts, resulting in low maintenance costs and requires comparatively little floor space.

FEATURES of this new machine include a single adjustment for obtaining uniform seams consistently, moderate spindle speeds which eliminate "bounce" over side seams, and insure positive sealing. In addition, the design of the end feed makes it possible to take a wider variation in end sizes.

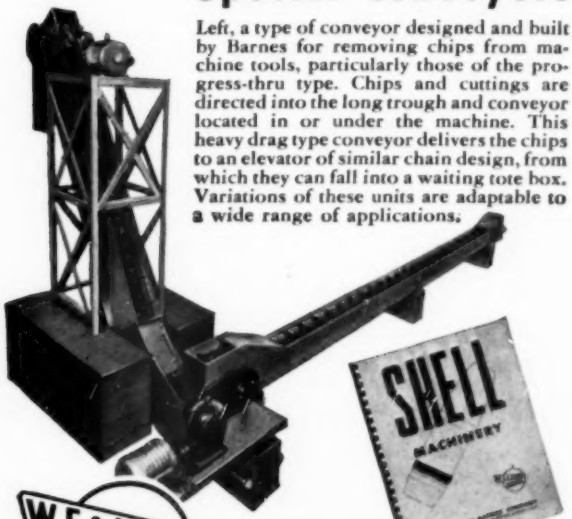


High Production Transfer-Type Machines

Above, many progress-thru type machine tools employ fixtures which must be returned to the loading end of the machine, and this special Barnes conveyor is built to accomplish this purpose automatically and in time with the cycle of the machine. The machine itself, and all its hydraulic equipment and control circuits are also Barnes products. This 24 station machine performs 116 operations automatically on compressor frames.

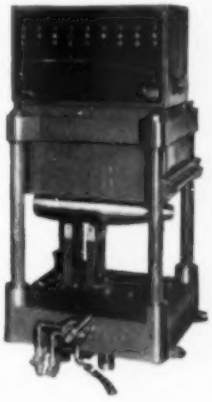
Special Conveyors

Left, a type of conveyor designed and built by Barnes for removing chips from machine tools, particularly those of the progress-thru type. Chips and cuttings are directed into the long trough and conveyor located in or under the machine. This heavy drag type conveyor delivers the chips to an elevator of similar chain design, from which they can fall into a waiting tote box. Variations of these units are adaptable to a wide range of applications.



Electrical Controls and Checking Equipment

Complete electrical circuits and controls have been designed by W. F. and John Barnes for a wide variety of installations. Shown to the right is an electronic gauge which simultaneously checks 9 significant dimensions on a 155 mm shell. Signal lights instantly indicate "over", "under", or "within limit" for each gauging point.

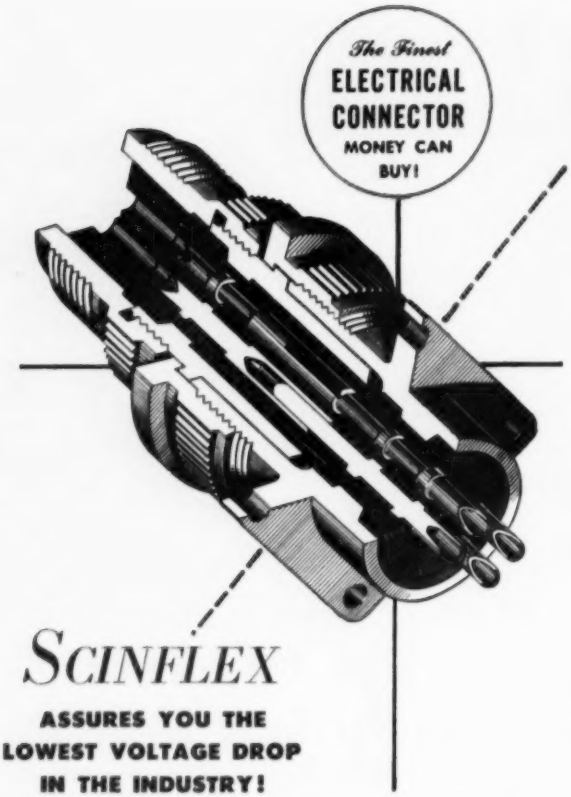


Free Additional Data

is available on all Barnes Ordnance equipment. Since it is impossible to give the complete scope of operation in this restricted space, we invite you to write for the complete Barnes Ordnance book **Ask for bulletin O-753**

W. F. and JOHN BARNES

PROCESS EQUIPMENT DIVISION 328 SOUTH WATER STREET, ROCKFORD, ILLINOIS



SCINFLEX

ASSURES YOU THE LOWEST VOLTAGE DROP IN THE INDUSTRY!

When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength remains well above requirements within the temperature range of −67°F to +275°F. It makes possible a design increasing resistance to flashover and creepage. It withstands maximum conditions of current and voltage without breakdown. But that is only part of the story. It's also the reason why they are vibration-proof and moisture-proof. So, naturally, it pays to specify Bendix Scinflex Connectors and get this extra protection. Our sales department will be glad to furnish complete information on request.

• Moisture-Proof • Radio Quiet • Single Piece Inserts • Vibration-Proof • Light Weight • High Insulation Resistance • High Resistance to Fuels and Oils • Fungus Resistant • Easy Assembly and Disassembly • Fewer Parts than any other Connector • No additional solder required.

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ELECTRICAL CONNECTORS

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COL. GEORGE S. BRADY, *consulting engineer, author, editor, Washington, D. C.*

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BRIG. GEN. THOMAS K. VINCENT, *artillerist, engineer, author, Redstone Arsenal, Huntsville, Ala.*

Wings for Peace—A Primer for a New Defense. By Brig. Gen. Bonner Fellers. Chicago: Henry Regnery Company. 248 pp. $3.50.

THE author of this book, although a ground officer, believes implicitly that the Western nations can never match numbers of men against the vast hordes of Russia and its satellites and that, like David against the giant, we must have a deadly sling ready to destroy her ability to wage war. He believes, also, that we cannot continue to toy with war or it will destroy us piecemeal.

In the first part of the book, which is devoted to a sharp analysis of NATO and to the Russian genius for keeping us engaged in a gigantic waste of materials against satellites without injury to herself, it is evident that the author is convinced that the American people are not being advised of real conditions.

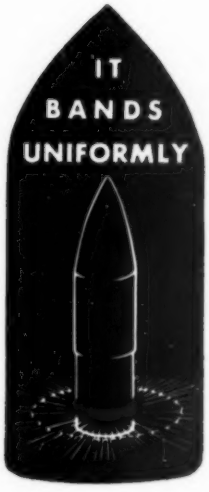
The author believes that Western Europe has a lack of faith in NATO, and he himself feels that the plan for NATO ground defense is unsound. The present NATO crept in on the American people unawares, for as late as 1949 Secretary Acheson solemnly assured Congress that no American soldiers would be needed in Western Europe.

Reading this book one gets the view that we are fighting the wrong war in the wrong place at the wrong time with the wrong weapons and with the wrong leadership—diplomatic instead of military.

In March 1951, our military intelligence learned that China's

FOR MORE OF WHAT THEY NEED...

ESTABLISHED 1848



The *WATSON-STILLMAN* Shell Banding Press

You produce *more* of vital ordnance for *less* when you replace obsolete shell-banding equipment with the high speed, single-squeeze Watson-Stillman Hydraulic Shell Banding Press. It operates at rates up to 250 rounds per hour on 90, 105, 120, and 155 mm shells. Everything except the loading operation is carried out automatically. Shells come out more uniform . . . fewer rejects . . . man-hours become more productive . . . less fatiguing.

Applicable to either conventional or powdered metal bands. This unit features flexibility and compact construction. It can be operated in the horizontal position for light work, or is easily converted to work in vertical plane for heavy shell. Height is only 3 ft. with floor space requirements held down to fifty square feet.

Write today for complete details, or arrange for a call by our representative.

THE WATSON-STILLMAN COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.

164 ALDENE RD., ROSELLE, NEW JERSEY

9-0-69

W-S Shell-Line Hydraulic Presses for Shell Billet-Breaking, Piercing, Drawing, Nosing, Banding, Crimping, Loading.

Rockwell Report

by **W. F. ROCKWELL, JR.**
President
Rockwell Manufacturing Company

OVER THE PAST TWENTY YEARS, Industrial Engineers have worked miracles in keeping the unit cost of manufactured goods down in the face of constantly rising material and labor prices. And by doing their job so well, they have in a sense made it more difficult. Our own Industrial Engineering Department has to look harder and harder for unnecessary costs. Sometimes they find them in surprising places.

In one of our plants an assembly operation was redesigned to make it more compact and provide needed space for warehousing. An unexpected dividend was a substantial saving in assembly time and materials handling cost.

While not relaxing our efforts to keep direct production costs at the lowest possible level consistent with quality, we have given greater and greater attention to service operations which are so often overlooked.

In shipping and maintenance departments, for instance, wonders can be worked by using the same principles applied on the production line: arrangement of facilities for a natural, efficient flow of work—and the application of proper tools for the job. Since many of the products of our Delta Power Tool Division are perfectly adapted to shipping and maintenance work, we are uniquely fortunate in being able to experiment constantly in the application of the right tool or combination of tools in cutting our own shipping and maintenance costs. Information gained in this way has been valuable to our customers, too.

* * *

Measurement from a distance with the meter reading remotely located from the source is proving popular in industry. Our remote registration system of metering, originally developed for the oil industry, is finding new uses every day. Railroads are interested for the fueling pits of Diesel locomotives, processors and blenders for the supervisory control the system permits over the handling and dispensing of valuable liquids.

* * *

New Rockwell Products: For measuring stations in the gas industry, where a wide variation of flow conditions is encountered, we have introduced a new differential controller which opens a Nordstrom valve at a predetermined setting to cut in an additional orifice meter to keep up with the recording of heavy loads . . . Also for the gas industry, we have developed a new farm tap regulator which permits customers in isolated locations to be served from high pressure gas transmission lines running through their area. The regulator reduces high line pressures to a point where a conventional service regulator can safely handle the load for domestic use . . . Our Delta Power Tool Division is offering a new moulding cutterhead set which for $9.95 converts a standard Delta circular saw into a machine for making wood mouldings and shaped edges for cabinets, tables, picture frames and the like.

* * *

Since 1947, over 100 municipal taxicab ordinances have been rewritten to specify the use of taximeters. The riding public, cab owners, cab drivers and city officials all benefit by a change from flat or zoned rates to meter rates. This fact has been proved for many years in practically every large American city. Like the largest fleet operators, most of these new metered operations are using Ohmer taximeters, made by our Register Division.

* * *

Our Secretary's office came up with an interesting statistic the other day. Ten years ago we had eight times as many employees as stockholders; now we have 50 per cent more stockholders than employees.

One of a series of informal reports on the operations and growth of the
ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.
for its customers, suppliers, employees, stockholders, and other friends

Book Reviews

General Lin Po-chen notified Peiping that he was in a hopeless position fighting artillery and tanks with human bodies, and he asked for cease-fire negotiations to give time for a build-up.

The Chinese power in Korea could have been smashed then and there, but the Western diplomats fell into the trap, agreeing to a talkfest that permitted building up the Red sanctuary in Manchuria.

The same procedure can be repeated later in Europe, with the Western nations butting their heads against the satellites while Russia plans and directs from a safe sanctuary.

However, the author does not feel that war is inevitable. He believes our superior technical genius and industrial capacity can achieve air supremacy and that if we then have a declared policy of intending to use that force against the real seat of hostile planning when we deem it necessary, we will not have war.—GEORGE S. BRADY.

Back Down the Ridge. By W. L. White. New York: Harcourt, Brace & Company. 182 pp. $3.

THE author of "They Were Expendable" has written another heart-gripping saga. This time it is the story of what happens to the men who get "clobbered" in Korea. It is written in the simple, moving words of an artist who uses them deftly and to excellent purpose. "Back Down the Ridge" is a litter-level view of the experiences, sufferings, and superb medical treatment of the forces in Korea, principally our own but also those of our allies, including the Turks and the increasingly effective Roks.

In the words of the author, "As these infantrymen, doctors, and nurses told their choral story another figure began struggling free of the typewriter keys. He is the average American boy, just under 20, who was pulled from his malted milks and basketball scores to be wounded in Korea. Much of this story is now of him and what he thinks, of his buddies, his weapons, his leaders, his allies and their enemies, and of this curious little war which all were sent out to fight."

"Back Down the Ridge" is one of the most compelling books yet to come out of the American venture in Korea.—L. A. CODD.

Fourteen Old Gun Catalogs. Third edition. Compiled by L. D. Satterlee. Chicago: The Gun Digest Company. $7.50.

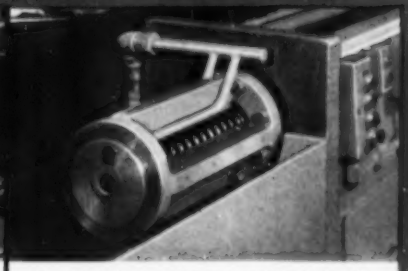
THE appearance of a 2,000-copy third edition of this work will make available to many gun lovers source material on American small arms heretofore dispensed in such homeopathic doses that few have

when designing

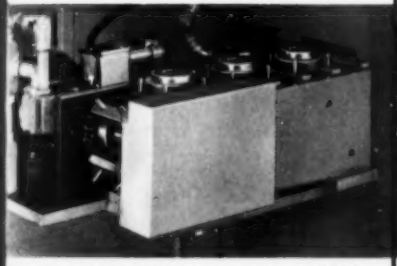
BROACHING FIXTURES

you need more than just a "hunch"!

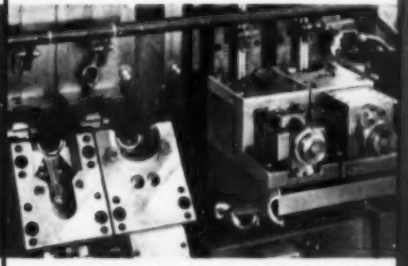
Close tolerance and exact spacing of holes in tank track shoes are made possible by this Lapointe V-8 Broaching Machine fixture.



Broach die-holding fixture, specially designed for easy coolant access and disposal of chips.

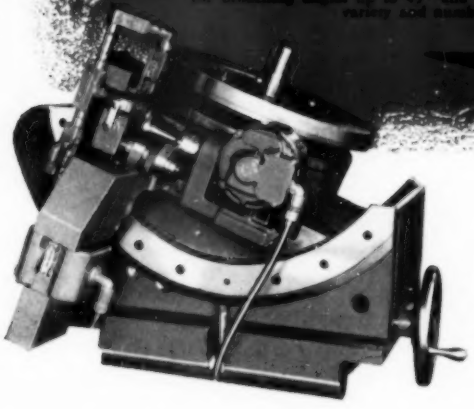


Operated unattended because of several built-in safety features, the Lapointe VU-3 Broaching Machine can broach helical splines in automotive gears through the use of this conveyor fixture.



The "Tip-Down" Fixture, exclusive with Lapointe, tips down to a position for easy loading, minimizes operator fatigue. Shown here on 15-ton Lapointe DRV Machine, for broaching connecting rods and caps.

Lapointe Universal Semi-Automatic Angle [illegible] fixture for broaching angles up to 45° and maximum [illegible] variety and number of slots.



Varied fixture requirements of the different types of broaching machines — single ram and double ram, vertical and horizontal — call for engineering skill in fixture design that can only be gained through long experience. Lapointe engineers, with their 50 years of background, can refer to countless designs involving fixture principles that show remarkable ingenuity.

Whether, therefore, your need is for a broaching fixture that is simple or complex, manual or automatic, come to "fixture headquarters" . . . come to LAPOINTE.

Literature on broaching machine fixtures can be obtained by addressing Department 14.

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LEFT: Parts entering roller hearth furnace on "Serpentine" trays.
BELOW: "Serpentine" trays on loading table.

"SERPENTINE" DESIGN *minimizes* WARPAGE...
LOWERS HOUR-COSTS FOR FURNACE TRAYS AT
PRATT & WHITNEY AIRCRAFT

Rolock "Serpentine' furnace trays are carrying jet engine parts through a Westinghouse roller hearth furnace with an Exothermic atmosphere at maximum temperature of 2050°F.

Rolock quoted on another type of tray as well as the "Serpentine," but 100 "Serpentine" trays were purchased for original equipment and have so far had many months of continuous use . . . with additional orders placed during that time.

The exclusive Rolock Serpentine construction gives freedom to expansion and contraction in both directions, minimizing warping to a greater degree than any other furnace tray Rolock has seen. It is available to order in any practical length, width and depth . . . as a tray or as the base of a basket or crate.

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Book Reviews

been able to obtain specimens. (The first printing in 1941 comprised but 250 copies, the second in 1943, 100 only.)

It is to be hoped that response to the present issue will be sufficiently enthusiastic to warrant the republication of another of Satterlee's compilations—"Ten Old Gun Catatogs" (Detroit, private printing, 1940)—a gesture now being considered by the Gun Digest Company.

The current reprint of "Fourteen Old Gun Catalogs" contains some very comestible literary provender. Basically devoted to literature on the Sharps rifle, it offers eight different editions of catalogs issued by makers of that famous arm. These date from 1859 to 1880. There is also a large section which records a court action brought against the Sharps company. Additionally present are single specimens of catalogs from four other makers—Maynard (1865), Marlin-Ballard and Stevens (both 1888), and Stevens-Pope (1902). All are replete with fascinating material well worthy of detailed study. (However, an actual count of catalogs reprinted yields twelve only. How Satterlee figures it at fourteen, I cannot see.)

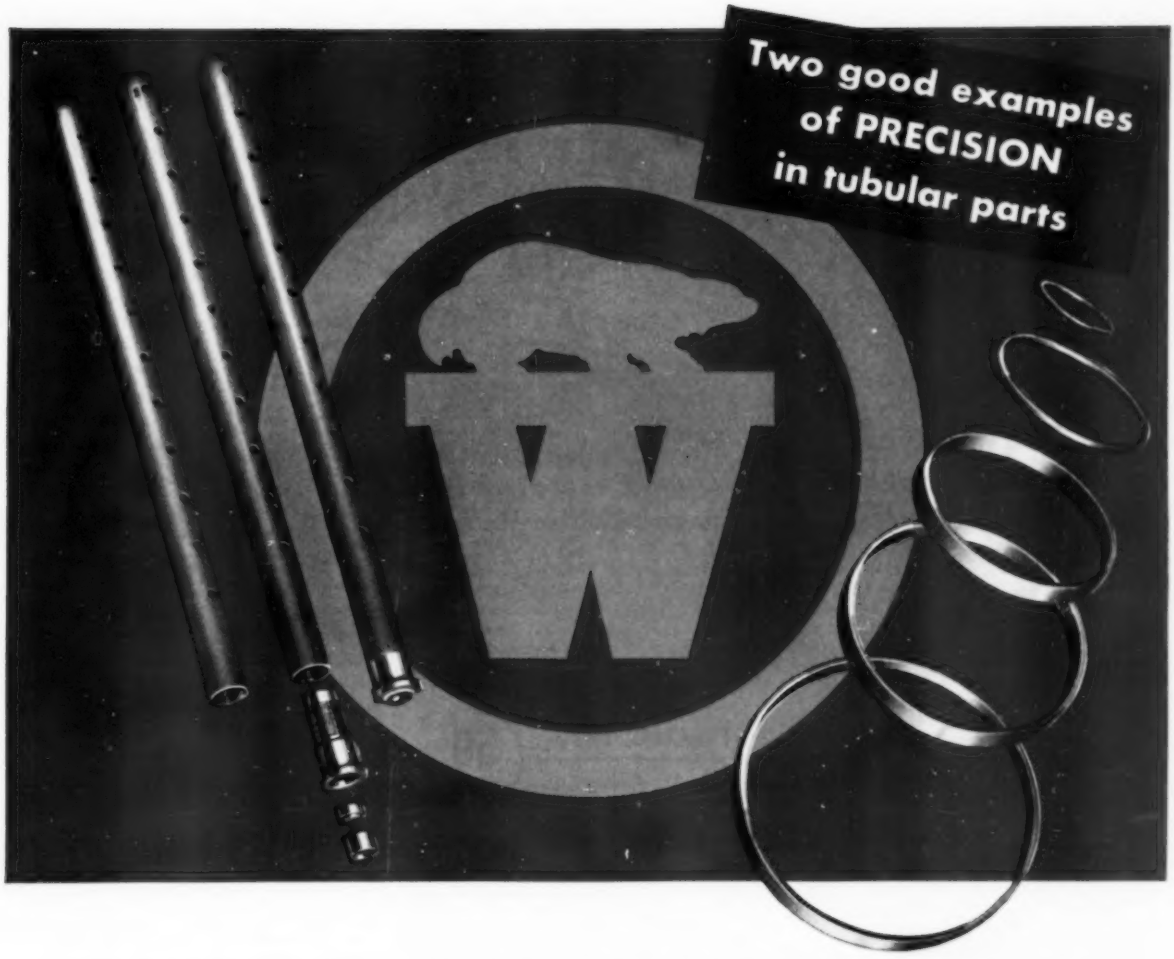
Certain items are arresting. Thus we find cuts of the Model 1875 Sharps, a type practically unknown to today's collector because of its limited production. *Per contra*, I uncovered no illustration or description of the Model 1879 (presumably an improved M'78), several varieties of which are described by Smith (Winston O. Smith, "The Sharps Rifle," William Morrow & Company, N.Y., 1943). Also, as in Smith's excellent volume, no cut of the most famous Sharps catridge of them all, the .45-120-550 with 3¼-inch case, appears, nor is the load anywhere mentioned.

Again, none of the caliber .50 Sharps cartridges are illustrated, though two types in this caliber (with case lengths of 1 3/5-inches and 2½-inches) are listed. The first of these was the solid old .50-70 Government cartridge, the second a special .50-100 load developed by or for Sharps. But the king of all Sharps cartridges, in size if not in fame—the .50-3¼-170, with its 700-grain bullet, is silently passed over.

The old-timer will peruse this volume with nostalgia; the youngster with amazement. Both will enjoy it no end.—CALVIN GODDARD.

Materials Handling. By John R. Immer. New York: McGraw-Hill Book Company. 591 pp. $8.

MR. IMMER'S text is a practical working guide presenting a common-sense program for attaining the goal of greater efficiency by means of materials handling.



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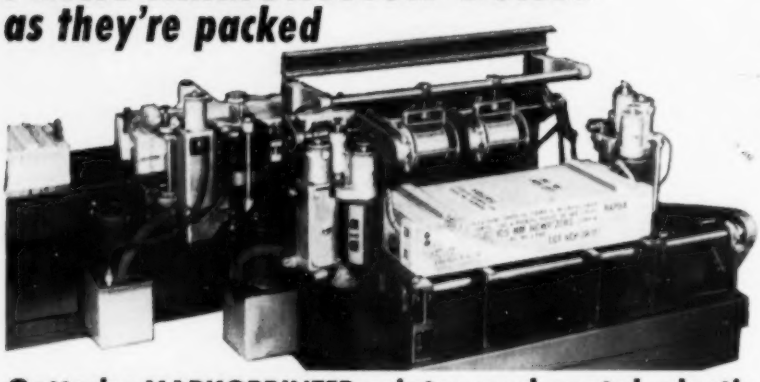

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The first practical answer to in-plant printing of completely assembled boxes — large and small — this machine is now effecting huge savings in ordnance plants throughout the country. The MARKOPRINTER prints all identification copy and changeable dates, weights, lot numbers on all four sides and top of boxes simultaneously . . . as part of the packing operation. The resulting savings: lower unit cost of boxes . . . no labor cost for marking . . . smaller inventory and space requirements . . . no box supply problems.

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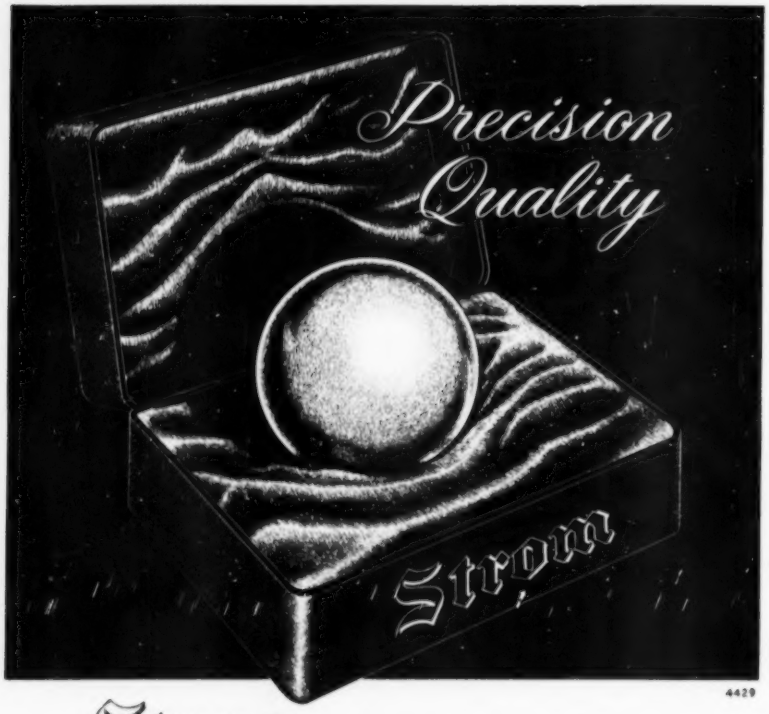

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Book Reviews

Too often producers have neglected or overlooked the costs and savings involved in materials handling. Today, increased efficiency in materials affords manufacturers the means of increasing production within existing premises and maintaining unit costs in spite of rising material costs and wage rates.

This book is founded on a solid basis of the experience of experts from various industries. Case histories are presented in abundance with the fundamental issues and basic principles of each thoroughly discussed.

Special emphasis is placed on the engineering and business aspects of the materials problem. The text presents a comprehensive analysis of types of surveys to be conducted, cost-accounting systems, and determination of handling costs. The dollar-and-cents aspect of materials handling is strongly presented.

To round out the subject, research and advances in the field of materials handling are realistically treated. Finally, the author also presents a wealth of teaching aids, including bibliographies and a list of films.—S. M. SMOLENSKY.

March or Die. By Howard Swiggett. New York: G. P. Putnam's Sons. 239 pp. $3.75.

THIS is the story of the French Foreign Legion, not as depicted in "Beau Geste," with its cruel officers, brutal noncoms, and criminals, but written without restraint and without glamour other than that which is normal to the Legion. This is not fiction but an historical account of the Legion written to correct mistaken ideas.

It disposes of the notion that the officers of the Legion are castoffs from the French Army. The top graduates of St. Cyr are allowed to select the Legion or the Chasseurs Alpin, just as our U.S.M.A. top graduates may select the Corps of Engineers.

The "mystique" of the Legion is a reality; that they are "stronger" than other men, is their credo. Their day at Camerone in Mexico stirs the coldest heart and is the riddle and its answer as to why legionnaires are as they are.

The Legion has been cruelly maligned in the movies and in fiction, and nothing refutes the officer-legionnaire hate attitude as much as the countless incidents in its history of the men protecting and rescuing their officers in battle. No wounded or dead legionnaire is ever left on the field.

The legionnaire's privilege would be a duty in any other army. He is privileged to serve in Africa, and his greatest privilege and opportunity is to march or die.—T. K. VINCENT.

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Book Reviews

Broadax and Bayonet: The Rôle of the United States Army in the Development of the Northwest, 1815-1860. By Francis Paul Prucha. Madison, Wis.: State Historical Society of Wisconsin. 263 pp. $4.

IN its work on the advancing frontiers of Illinois, Iowa, Wisconsin, and Minnesota the Army, though always ready to perform its primary function of defensive or punitive fighting, functioned to a large extent as a highly disciplined body of pioneers. This work, so little known to the American people of our time, Mr. Prucha gives us in this noteworthy historical piece.

As the sole authority in this vast region for much of the period, the Army's rôle was that of civil government as well as that of buffer between savage and settler. The years between 1815 and 1860 are admirably chosen for the work; for they cover the transition from a nearly primeval wilderness to an orderly civil control.

The greatest work of the Army, that of keeping the peace, is objectively told. Though it was not uniformly successful in this endeavor, there can be no reasonable doubt that without the Army's presence there would have been no peace or orderly government at all.

The nonmilitary work of the troops, that of the actual construction of the forts which became settlements, roads and bridges, and the clearing of land, is given in great detail and with thorough documentation.

"Broadax and Bayonet" is illustrated with numerous photographs and some rare woodcuts. While not light reading, this study of the American frontier will appeal to the pioneer interest of most men and will prove of much value to the student of Americana.—F. W. FOSTER GLEASON.

Orders and Directives—A guide for Commanders, Staff Officers and N.C.O.'s. By Maj. Arthur M. Chester and Maj. John E. Murray. Washington: Combat Forces Press. 176 pp. $3.

THIS book, similar to others which have been written to interpret and integrate Government regulations with customs and traditions, is very readable and is excellent for the purpose intended. Any one concerned with the issuance of military orders and directives will find this a very useful reference.

For those not directly connected with the issuance of military orders and directives the book might be of general interest, especially the definition of military terms contained in the last chapter, since it clarifies to some extent military "red tape."—COL. JOHN D. BILLINGSLEY.

American Ordnance Association

BOOK SERVICE

Book of the Month for September

The Challenge to American Foreign Policy

By John J. McCloy

Few have enjoyed opportunities for observing the working of our foreign policy as has our former Commissioner to West Germany. He realizes the Soviet menace and the terrific difficulties of getting coöperation from a weary and disunited Europe. Mr. McCloy's warning is most timely: having deeply embroiled ourselves in the world's quarrels, we must lose no more time in straightening out our decisions and their implementation. Retail, $2.00. To Members, $1.80.

Report on Mao's Red China

By Frank Moraes

Mr. Moraes has turned in a quite factual and objective report on the Chinese dictatorship from an Asiatic viewpoint which aids in estimating this great enigma. Retail, $3.75. To Members, $3.37.

A Century of Conflict:

Communist Techniques of World Revolution

By Stefan T. Possony

Mr. Possony gives us a stimulating and very useful study of the strategy of total force which has animated the Soviets and their friends. There cannot be too much attention to the workings of this sinister plot. Retail price, $7.50. To Members, $6.75.

Malenkov: Stalin's Successor

By Martin Ebon

So little is know about the man who is now locked in a death grapple for the rule of the Soviet empire that Martin Ebon's book will be most helpful. It is through his recent speeches and his associates that the author, an experienced writer on Communism, depicts Malenkov. Consideration of the Red dictator's comrades—any of whom may be his quick successor—adds to the book's informative value. Retail price, $3.75. To Members, $3.37.

New Guinea and the Marianas: March 1944 to August 1944

Vol. VIII of The History of United States Naval Operations in World War II

By Samuel Eliot Morrison

The great historical experience of the author and the able assistance of the Navy combine to produce the first comprehensive and accurate account of the Battle of the Philippine Sea. It forms a masterly picture of this part of the war but must be fitted into the fourteen volumes of the completed series. Retail price, $6.00. To Members, $5.40.

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Book Reviews

Peace Through Strength. By Morris V. Rosenbloom. New York: Farrar, Straus & Young, Inc. 325 pp. $3.95.

NO other American citizen has given so consistently, reliably, and factually the pattern which must be followed for strengthening our economic structure to meet the stresses of war than has Bernard Baruch. Chairman of the War Industries Board in the First World War, Mr. Baruch during the thirty-five years since then has sounded a clarion call in season and out of season for a realistic and efficient industrial and economic mobilization plan.

His lectures, appearances before congressional committees, and major addresses during nearly four decades have emphasized constantly and without fear or favor the necessity for peacetime industrial mobilization plans and for stern, prompt, and fearless action to put those plans into being when war is imminent.

Many of his counsels have been published in the pages of the journal of the American Ordnance Association, of which Mr. Baruch is a charter life member. The Association awarded him its highest honor by conferring upon him its Crozier Medal in 1935.

In this volume Lieutenant Rosenbloom, U. S. N. R., has gathered together a summary and commentary upon the most significant recommendations which Mr. Baruch has made to our last six Presidents. Mr. Baruch's preparedness philosophy is summed up in his injunction: "We should think peace, talk peace, and act peace, but if war comes we should be prepared to fight it, to win it, and to survive it."—L. A. Cobb.

The Long Way Round. By Pat Frank. Philadelphia: J. B. Lippincott & Company. 221 pp. $3.

THIS book is classified as nonfiction, but it contains many interesting stories which the reader may not be sure represent fact or fancy. The stories are about conditions in Japan and Korea primarily. They also cover briefly other cities of Asia. In addition there are numerous flashbacks to the World War II experiences of the author. During World War II he served with the Office of War Information overseas and as a newspaper correspondent. He has already written a number of successful novels, one of them about front-line conditions and experiences of a retreating Marine company in Korea.

Mr. Frank was asked in 1952 to help make a documentary film of Korean civilian conditions for the United Nations. He received this request while he was living in Florida. Accordingly he writes the book about his travels to New York, by air through the Aleutians to Tokyo, then to Pusan, and finally Seoul.

This is a very readable book containing information about living conditions in rear areas of Korea, prepared by an experienced writer. However it contains little if any information of interest to Ordnance designers, producers, or to those engaged in "passing the ammunition."—Philip Schwartz.

Battle Cry. By Leon M. Uris. New York: G. P. Putnam's Sons. 505 pp. $3.75.

THIS is a novel about the Marines—in general about a battalion of the 6th Regiment commanded by Lieut. Col. Sam Huxley. In particular it concerns a radio squad in that battalion.

It starts with Pearl Harbor and the hero, if one can be singled out as such, enlists in the Marines and leaves his native Baltimore for San Diego and boot camp. The reader lives through boot camp with him and his buddies after which comes combat in the Pacific—Guadalcanal, Tarawa, and other places.

This is not an ordinary novel and is not concerned with an ordinary subject. The glamour of the Marines is traditional, but the basic elements of "why a Marine?," the fundamentals which each Marine must possess and which he guards, and the fierceness with which he contends that he and the Corps are superior to all other services are impressed upon the reader again and again.

General McCaul, Director of Public Relations for the U.S.M.C., says "Sure it's got guts, sure it's got gore, but what it's got most of is—Glory." I heartily subscribe to that and feel privileged to have been allowed to review this book.—T. K. Vincent.

The Approach to the Philippines. By Robert Ross Smith. Washington: U.S. Government Printing Office. 578 pp. $5.50.

THIS is an extremely well documented and detailed account of the Army's operations along the north coast of New Guinea and in the southern Palaus from April to October 1944.

Mr. Smith is primarily concerned with land combat. He takes each campaign from Hollandia-Tanahmerah through Angaur and Peleliu and in almost microscopic detail develops the action from initial contact with the Japanese to the final securing of the area.

Nine operations are described in this volume. The detail entered into makes hard reading at times, but the over-all result is an accurate and complete accounting of the rough and little-known part of the war that opened the way to the Philippines.—R. E. Jeffery.

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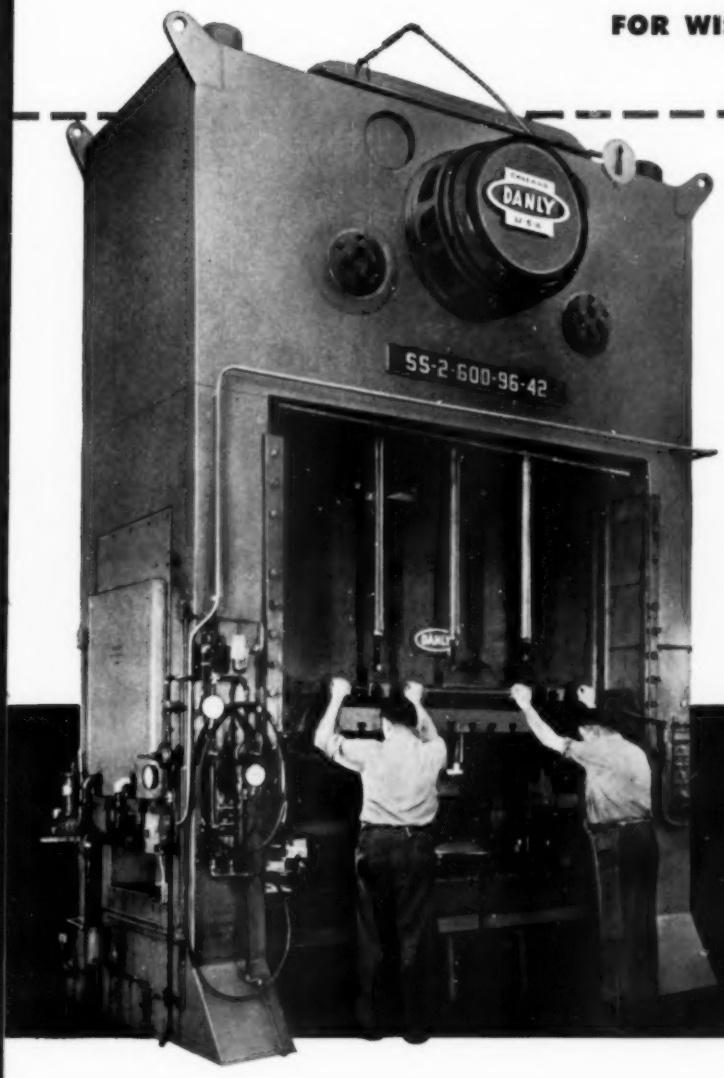

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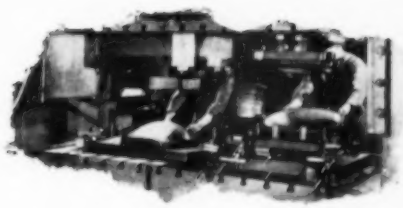

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4 single stage dies are involved in stamping a farm tractor seat pan . . . but only 2 stamping operations are necessary instead of 4! 2 operations are performed at one stroke. Dies are mounted two at a time to produce 300 pieces per hour—cutting production time in half!

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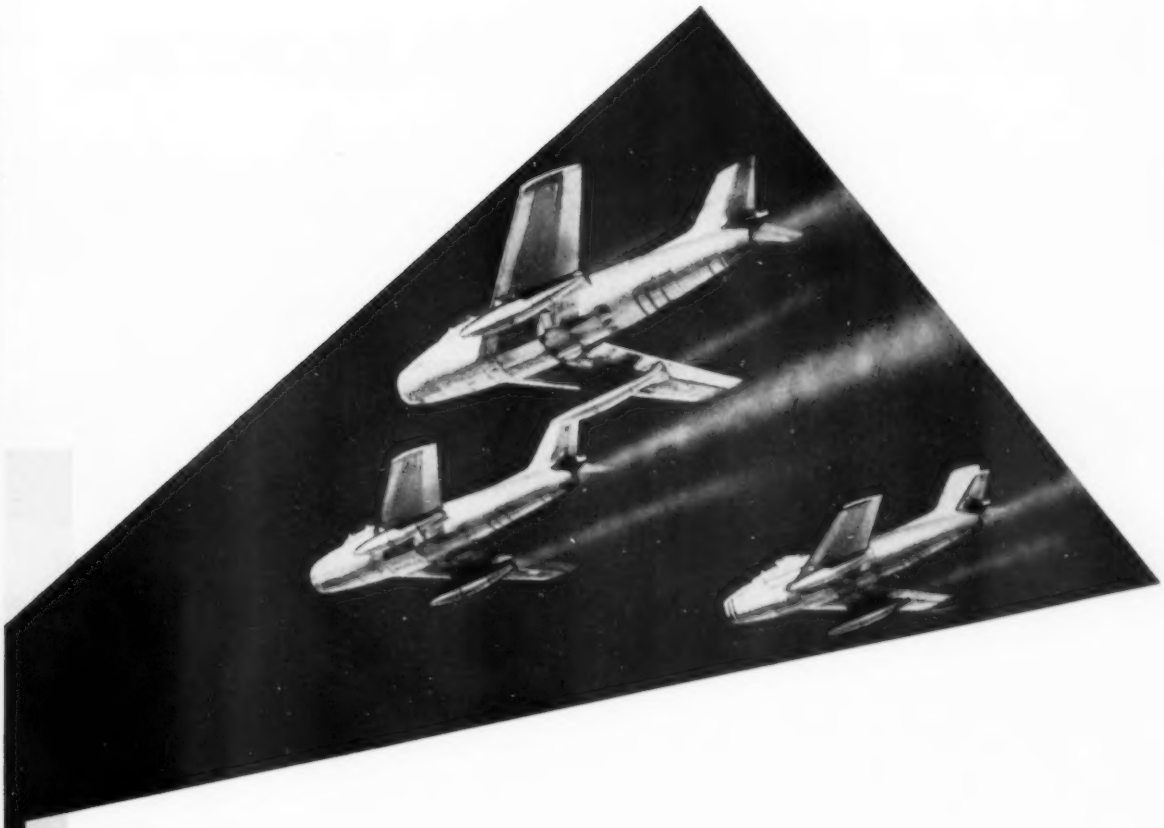
Time and Distance —
They were weapons that gave us the chance to win — yesterday —
To preserve the freedom we enjoy today.

What will save our freedom in the years to come? —
For our future and the future of our children —
Now that Time and Distance are no more —
Devoured by the swift wings of supersonic planes?

Look out the window. What do you see?
A peaceful city — the ferryboats plying their way across the river;
Or the smokestacks of your factory, busy with the tasks of peace?
Is that all?

You've missed something — factories halfway round the world,
working night and day, preparing the latest implements of war.
For what? To blast your factory — turn your peaceful city into
a shambles — wipe out your freedom.



What's the driving force behind all this hostile activity?
The foresight and imagination of zealous men who hate what you love
and love what you hate.

Are they smarter than we?
Do they know what they want more clearly than we?
Can they plan for the future more intelligently than we? —
Their future — to supplant ours?

Do you know any magic that can take the place of foresight?
Any fancy words that can do the work of hard, conscientious planning now? —
Any miracles to rely on as substitutes for intelligent preparedness?

The American Ordnance Association doesn't either.
That is why it works to develop the finest team of scientists
and industrialists, to cooperate with our military experts,
to perfect the best armament in the world —
and factories ready to augment its production — at a moment's notice.

All men of vision and understanding, with the will to win, are
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You get an experienced field engineer too, who can give you answers based on our 10 years of designing and producing winterization systems—over 100,000 installations—for all sizes and types of vehicles and equipment. Winterization Data File on request. Perfection Stove Company, 7390-D Platt Avenue, Cleveland 4, Ohio.

Perfection

One plating shift does the work of Two

Here was a plant that was hard chromium plating airplane parts to increase resistance to wear and corrosion. But the deposit being obtained was rough. They either had to take at least 4¼ hours to deposit the .004" thick chromium smoothly, or else do excessive grinding and polishing. This slow rate meant running over to a second shift to meet schedules.

But they found another alternative upon consulting United Chromium.

"The Unichrome Man" suggested an easy change-over from the ordinary solution to the Unichrome SRHS Chromium Solution. In over 700 commercial installations, this bath had demonstrated it virtually obsoletes chromium plating by any other methods. It plates a more level deposit 20% to 80% faster.

Result: The SRHS Solution produced a *smoother* .004" plate in only *three* hours – saving enough time to meet schedules in one shift instead of two.

MORE WAYS UNITED CHROMIUM HELPS TO SAVE ON COATING OF METALS

Paid for themselves. New England concern found that 2 Unichrome Tantalum Heating Coils in chromium bath had paid for themselves in 1 year by eliminating repair of former type of coils, and production loss. Now every additional year pays a *bonus.*

Saves $25,000. Tubular furniture manufacturer was able to use Unichrome Copper Plating Process in idle, rubber-lined nickel plating machine without alteration – thereby saving $25,000 installation cost.

Low Cost chromate finishing. The Anozinc* process means more economical mass production of uniform protective finishes on zinc plate. On a run of 26,000 shell cases, for example, one company got only 84 rejects. **Trade Mark*

TO FINISH IT BETTER AND SAVE

call in "The Unichrome Man"

UNICHROME

Trade Mark

It pays to consult United Chromium on Metal Finishing Problems

United Chromium offers you the advantages of: (1) 25 years of specialized experience in metal finishing; (2) Wide experience in *both* organic and plated finishes; (3) A diversified line of products for decorative and functional finishing – including plating processes, protective coatings, chemical conversion coatings for zinc; (4) Thinking geared to *cost-cutting, product-improving* possibilities.

We'd welcome an opportunity to help you "Finish it better AND SAVE."

UNITED CHROMIUM, INCORPORATED 100 East 42nd St., New York 17, N. Y.

Waterbury 20, Conn. • Detroit 20, Mich. • Chicago 4, Ill. • Los Angeles 13, Calif. In Canada: United Chromium Limited, Toronto, Ont.

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when you call in ... PRECISION

Complicated CORING

Precision's ability to produce die castings involving complicated coring offers you these advantages:

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2. Combines several parts into one die casting, eliminating assembly operations.
3. Makes possible quantity production of intricate parts at much lower cost than by other casting methods.

Since 1909 the name "PRECISION" has been the symbol of highest quality in the die casting industry.

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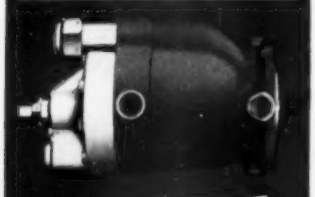
GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.



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Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.

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Hydraulic power for fire-control; elevating, traversing and loading guns; operation of turrets, steering mechanism and drive wheels of vehicles; materials handling; production and metal forming equipment; raising and lowering ramps, platforms, signal masts, derricks, etc.; powering controls and operational gear on amphibious craft, vehicles and aircraft.

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An exceptionally broad range of types, sizes and special constructions to handle virtually "any substance that will flow through a pipe" including: gasoline, acids, sludges, slurries, asphalt, fuel oil and other viscous and non-viscous fluids.

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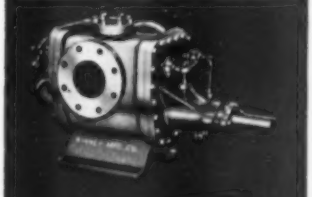
DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,000 lb. in.



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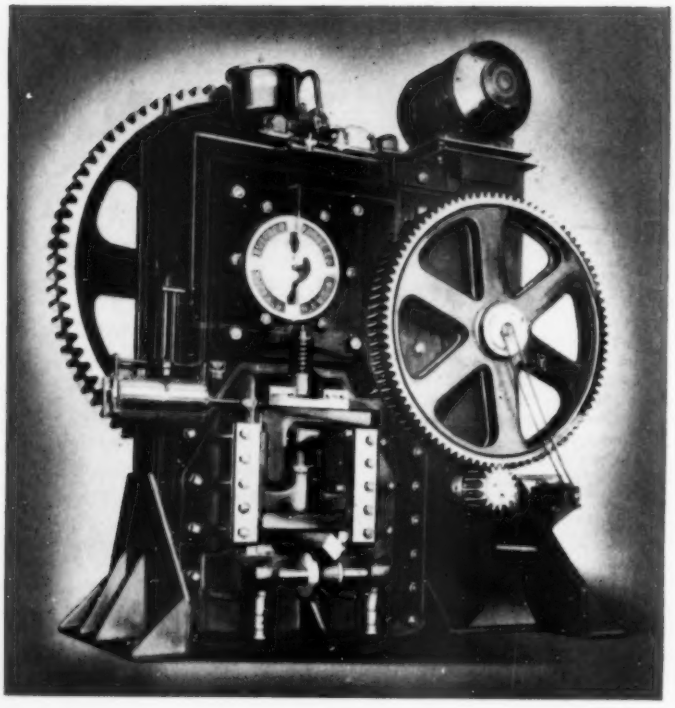
"Buffalo" Tips on Speeding Up Metalworking

SHEAR SHELL BLANKS *FASTER . . .*

. . . with the "shear-fracture" method. Widely used in preparing shell forgings, "Buffalo" Billet Shears produce cleaner, quicker cuts than any other method. There is no waste of material. Weight variation of multiples is held down to two ounces. All cuts are square with no "smearing", which permits accurate inspection for porosity. "Buffalo" Billet Shears are available in 11 sizes, from 110 to 2200-ton capacities, to cover the entire cold and hot range of alloy steels in rounds or squares. Available with power feed tables to handle 30-ft. billets with ease. Request Bulletin 3295 for all details on "Buffalo" Billet Shears.



PUNCH - SHEAR - NOTCH and COPE *ON ONE FAST MACHINE*

Often called the handiest machine in the shop, the "Buffalo" Universal Iron Worker will punch, shear, notch and cope without changing tools. The No. ½ Iron Worker at left is shown punching an angle and coping an angle simultaneously in a shop where it shortened a 9-day fabrication job to ½ day. Write for Bulletin 322 for all capacities and details.

IF YOU HAVE A METALWORKING JOB

which should be speeded up, write us about it. "Buffalo" manufactures a full line of drilling, punching, shearing, bending and wrapping machines long accepted by industry.

"Buffalo" MACHINE TOOLS

BUFFALO FORGE COMPANY

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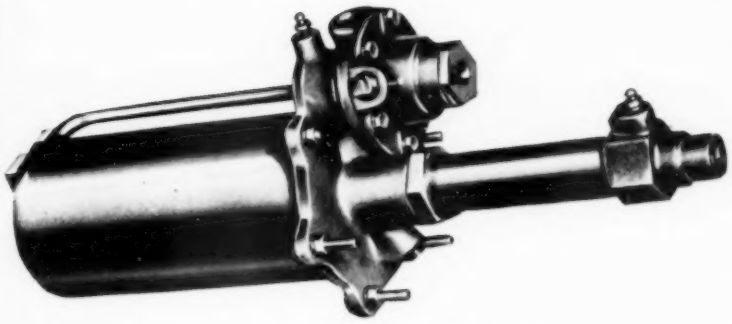
DRILLING PUNCHING SHEARING CUTTING BENDING

Bendix

AIR-PAK

offers the advantages of two braking systems in one unit

... air power plus hydraulic actuation



With Bendix* AIR-PAK you get faster brake action and more positive control, for here in a single, compact easy-to-install power braking unit are combined the well proven advantages of hydraulic brake action with an air brake system.

Bendix AIR-PAK changes air pressure into hydraulic pressure by means of two directly connected pistons. Thus, a non-compressible column of brake fluid instead of air connects between the driver's foot and the brake shoe. If in an emergency situation air pressure fails for any reason, or if braking is required before air pressure builds up, brakes can be applied instantly by foot power alone.

AIR-PAK is the product of Bendix—world's largest producer of power brakes and builder of Hydrovac*, the world's most widely used power brake with *over three million units in use.*

For truck manufacturers or operators interested in AIR-PAK, a descriptive folder is available on request.

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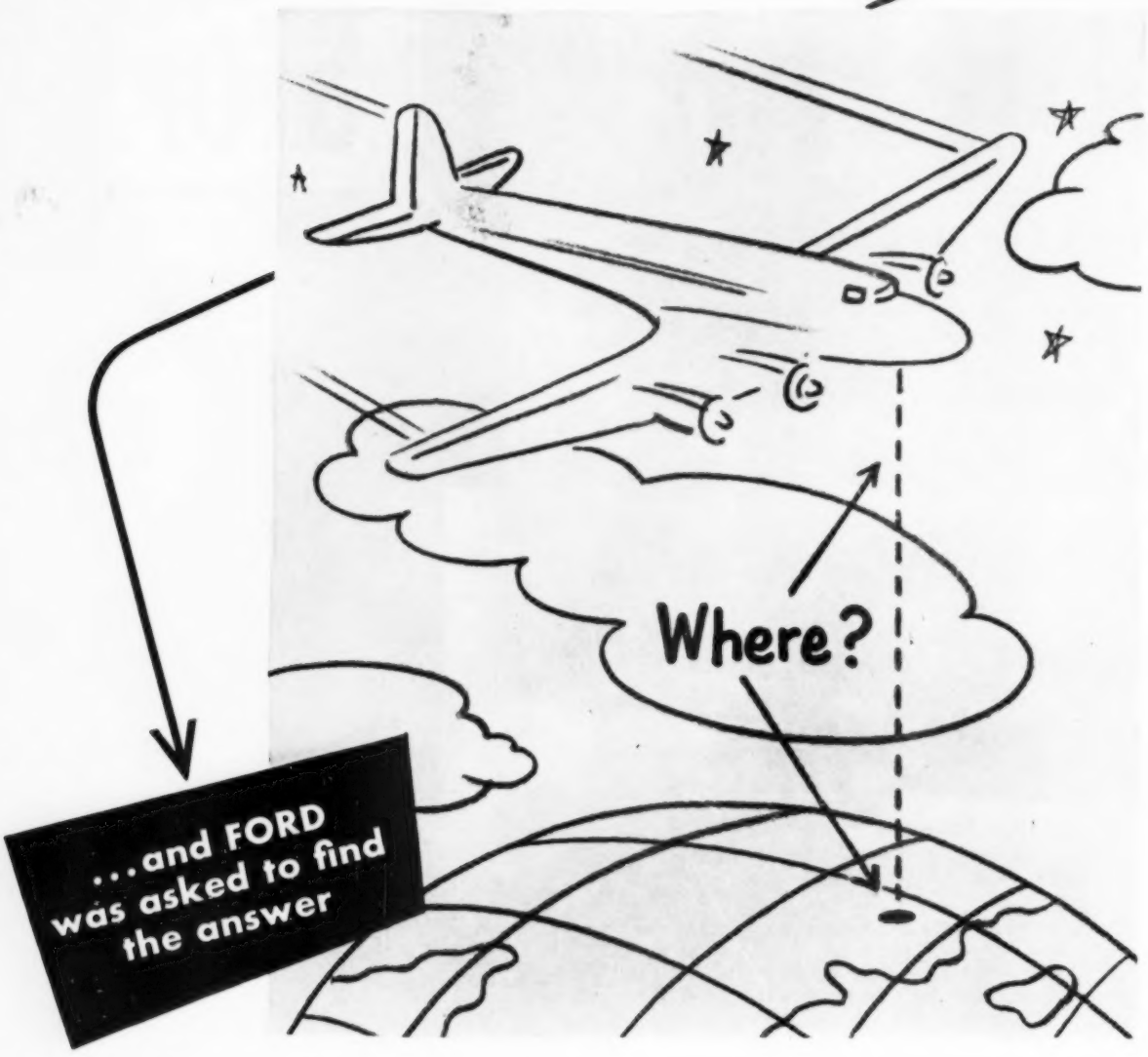
Bendix AVIATION CORPORATION

TO INDICATE aircraft position with no ground-to-air communication



Combat mission . . . or freight flight . . . now we are working to help the pilot locate his position without a radio beacon — merely by equipment right in the cockpit of his plane! Thanks to a Ford Instrument Company design, development and manufacture . . . another step is being taken toward greater flying safety.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electro-mechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

FORD

9

FORD INSTRUMENT COMPANY

DIVISION OF THE SPERRY CORPORATION

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G.P.&F. Produces 1,000,000th Ammunition Box

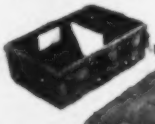
The Sheboygan, Wis., plant of Geuder, Paeschke & Frey Co., recently celebrated the completion of the one-millionth .30-cal. ammunition box it is now producing for the government. Shown in the photo above are, left to right: William Livingston, Assistant Chief of Purchasing, Chicago Ordnance District; Frank T. Frey, G. P. & F Executive Vice-President; Major E. A. Smith, personal representative of Colonel Haskell, Commanding Officer, Chicago Ordnance District; August K. Paeschke, G. P. & F. President; Major R. E. Ryan, Commanding Officer Milwaukee Regional Office, Chicago Ordnance District. G. P. & F.'s Sheboygan branch plant is devoted entirely to military production.

• Whether your requirements are for military use or civilian use—whether you need an ammunition box or a washing machine tub—if it's stamped or drawn, chances are that G. P. & F. can do it for you. When you think of G. P. & F., think of over 1000 skilled people . . . 15 acres of production facilities . . . 293 deep draw and stamping presses . . . 97 welding machines . . . a complete tool and die department.

METAL STAMPINGS FOR EVERY TYPE OF CIVILIAN AND MILITARY USE

Automobile Oil Pan
Hot Dip Lead Coated

Washing Machine Tub
Seamless Drawn—Vitreous Enameled



Radio Case
U. S. Signal Corps

Base for Power Lawn Mower
Seamless Drawn Steel

Aerial Delivery Container
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Scale Platter
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Tub and Cover for Portable Dishwasher
Seamless Drawn Aluminum—Baked Enamel Finish

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WELDING • SPRAY FINISHING
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Aero-Commander. Seats 6. Powered by two 260-h.p. Lycoming air-cooled, geared engines.

Grumman Widgeon Conversion. Amphibious flying "office" featuring 260-h.p. air-cooled, geared engines by Lycoming.

Safest "offices" over earth

You are now looking at the "wings" carrying America into a great new era of safe, economical executive transportation. Each of these twin-engine, multi-passenger planes is powered by Lycoming . . . long a leader in the up-to-500-h.p. engine field. Each has the double dependability of *two* air-cooled Lycoming engines—so powerful that the planes can safely fly and land with a full load *on one engine alone.*

To fly any time, any place . . . these are the safest "offices" *over* earth . . . the soundest investments in executive aircraft *on* earth. *For further information, write us on your letterhead.*

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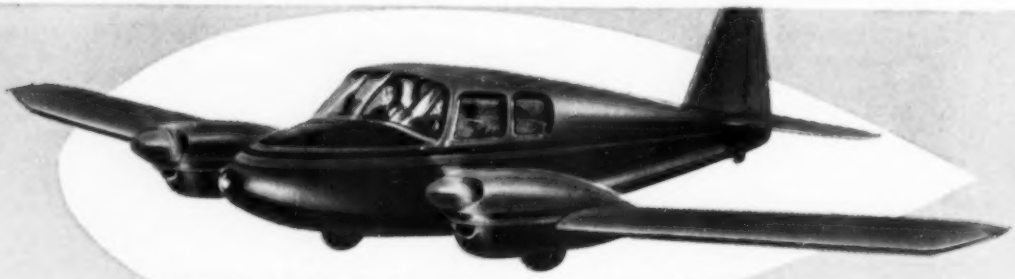
LOOK TO **LYCOMING**

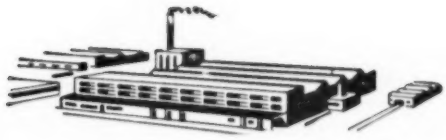
Lycoming-Spencer Division, Williamsport, Pa. AVCO Bridgeport-Lycoming Division, Stratford, Conn.

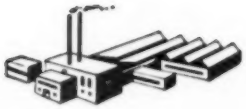
Air-Cooled Engines for Aircraft and Industrial Uses. Precision-and-Volume Machine Parts. Gray-Iron Castings. Steel-Plate Fabrication

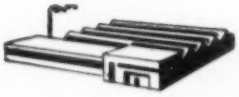


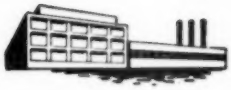
Piper Apache. Seats 4. Dependably powered by two 150-h.p. air-cooled Lycoming engines.

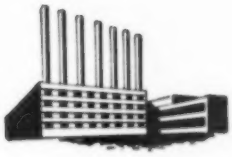
Riley Twin Navion Conversion. 4-place executive plane powered by two 150-h.p. air-cooled Lycoming engines.











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ALL OUTSTANDING PERFORMERS — *these products range from . . . . . .*

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Riverside Foundry is ready to give you excellent service on cast armor and all types of QQS 681-B materials. In fact, any steel casting specifications for which your contract might call. We have a full staff of men who have spent years producing ordnance material.

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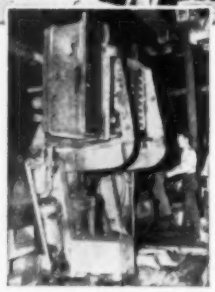
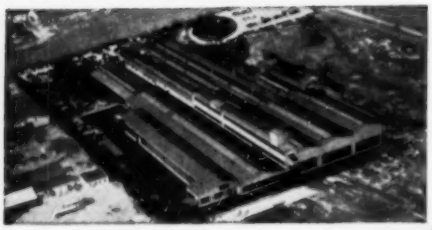


Call or write us at Riverside today.

For a dependable qualified source of steel casting requirements, see Riverside. You give us your drawings. The rest of the job is ours. Save yourself time, worry and loss of production. We are ready to do a complete job for you on any casting requirement.



The big modern Riverside Foundry at Bettendorf, Iowa has the best equipment to do the best job.

an easy way to cut your production costs

OILITE does it—

with FINISHED MACHINE PARTS

machining this segment costs ..... $.70

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Other Advantages Include:

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If you are searching for a specific size or type... if availability is a problem... if engineering counsel is needed... Ketay can help. Why not join us for an exploratory discussion of your particular problem. Write today to Dept. J.

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1. SYNCHRO, Size 16, O.D. 1.537", 115 V, 400 Cycles *(Transmitter, Receiver, Control Transformer)*
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5. SYNCHRO, O.D. 1.437", 14.4 V and 26 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
6. SERVO MOTOR Mk 7, O.D. 1.437", 115 V, 400 Cycles
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13. SERVO MOTOR, O.D. 1.062", 115 V, 400 Cycles
14. SYNCHRO, Size 15, O.D. 1.437", 26 V and 115 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
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DESIGN **DEVELOPMENT** **MANUFACTURE** ...of precision instruments, components, and systems.

- *KINETIX INSTRUMENT DIVISION*
- *RESEARCH & DEVELOPMENT DIVISION*

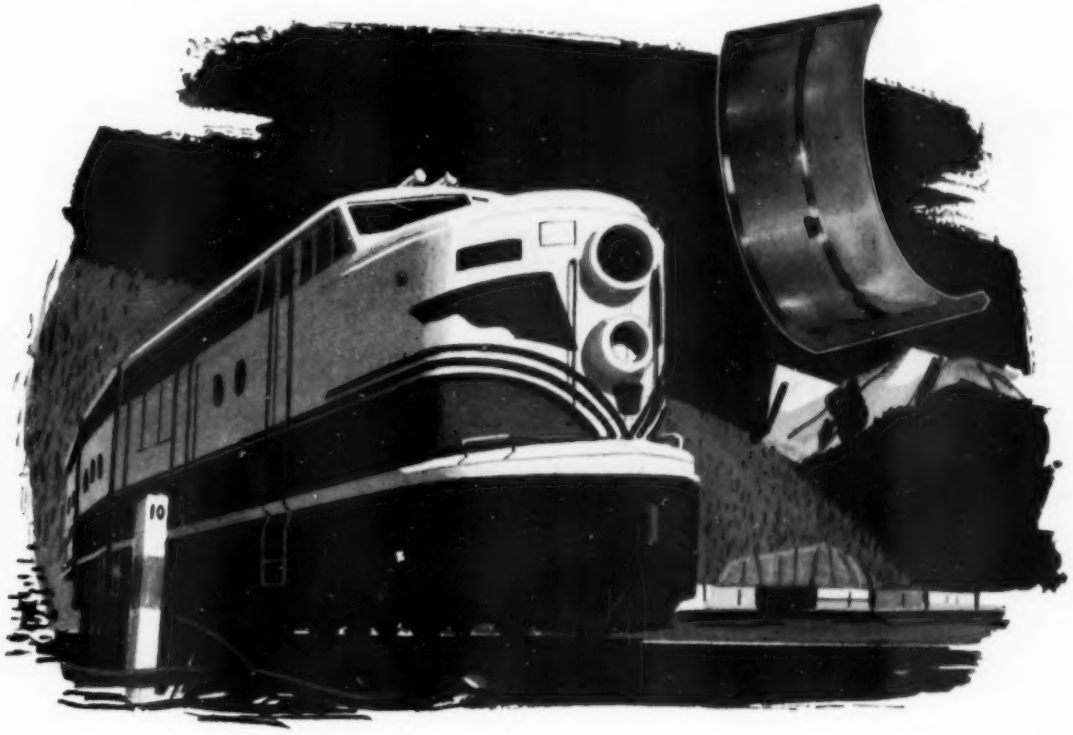
ALUMINUM IS *Why* THESE LOCOMOTIVE ENGINE BEARINGS NOW LAST MANY TIMES LONGER

This is the story of the Fairbanks-Morse 8⅛" Opposed Piston Diesel Engine and solid aluminum bearings.

They saw the possibilities offered by the solid aluminum bearing in their 8⅛" diesel engine after considerable laboratory and field testing in various models of their own engines since 1944.

They standardized on solid aluminum bearings for their main, connecting rod and camshaft bearings in the Opposed Piston Diesel Locomotive Engine for both main line and switcher service. Recent reports show millions of miles of successful operation to date. In fact, railroads are requesting aluminum bearings for this tough service.

Aluminum bearings give such outstanding performance because they are solid metal all the way through. There are no bonds to fail. Corrosion resistant and no hard backing to score the shaft. No localized hot spots because they dissipate heat far faster than other bearings.



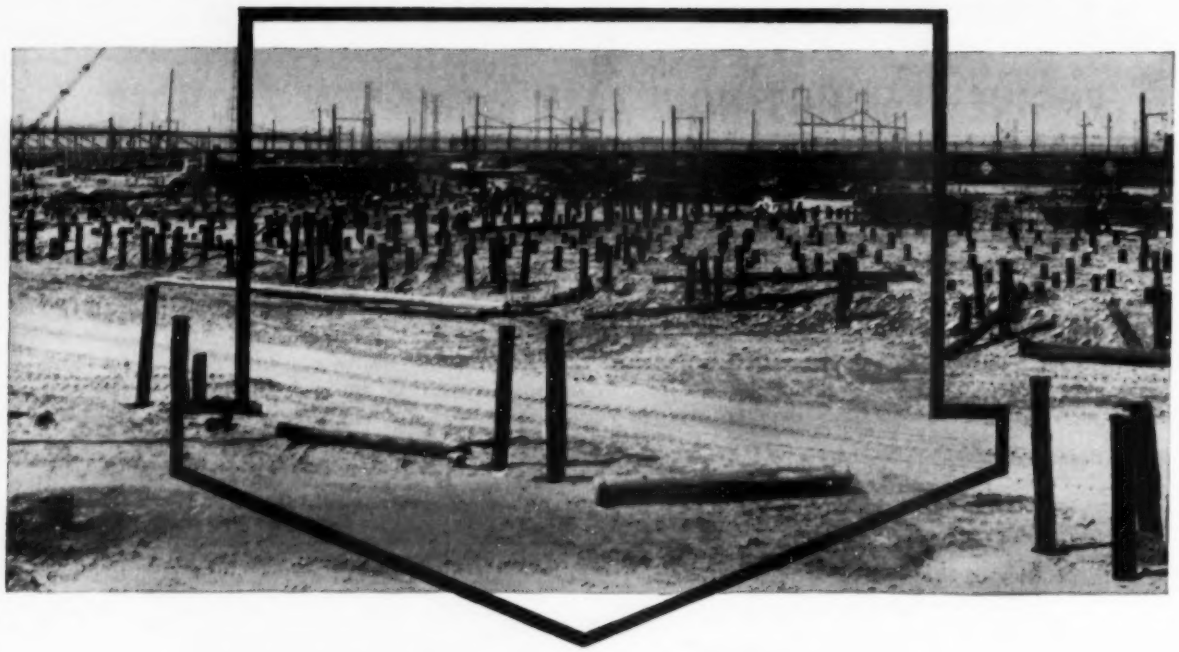
ALCOA IS *How*

To interest users of bearings in aluminum, we had to develop a suitable alloy—one that has good bearing properties, yet can be cast. We had to prove the bearings in thousands of hours of scuff tests, corrosion tests, engine operation on dynamometers, and actual engine field tests. On this firm basis, we became the country's leading producer of aluminum bearing materials. Our stake in the business is to sell sound aluminum castings to bearing finishers and equipment builders, and provide the kind of help in applying them that has made aluminum useful to countless industries. For complete details, call your local Alcoa sales engineer, or write: Aluminum Company of America, 850-J Alcoa Building, Pittsburgh 19, Pennsylvania.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

Pressure-Creosoted Piles, Driven Upside-Down,



Save Half a Million Dollars in Warehouse Construction

DRIVING pressure-creosoted timber piles with the big end down saved half a million dollars for Safeway Stores, Inc., on the construction of a warehouse in Kearny, New Jersey, by the Turner Construction Company. Alexander D. Crosett & Associates were the architects. A readily reachable stratum of sand, upon which the engineers intended to support the piles, was not sufficiently thick or dense to prevent the 8-inch-tip piles from punching through. Piles long enough to reach a lower stratum adequate to support the structure, would have been difficult and extremely costly.

To meet this unusual situation, the foundation consultants on the project, Moran, Proctor, Mueser and Rutledge, recommended that the timber piles be driven with the large end down. 8-inch-tip, 12-inch-butt pressure-creosoted piles were driven at about 6-foot center-to-center to support the building.

This butt-end down system made the installation of extremely long piles unnecessary, and resulted in very large savings. In addition, a considerable amount of valuable time was saved—time which would have been consumed in driving long piles. The driven piles, over 7500 of them, were remarkably firm laterally, withstanding individual load tests of twice their designed intensity, i.e., 25 tons.

Koppers Pressure-Creosoted Foundation Piles support all types of industrial and commercial structures —provide lasting protection against fungi, termites, and acids in the soil.

For information on price and delivery, write:

KOPPERS COMPANY, INC.
Wood Preserving Division, Pittsburgh 19, Pennsylvania

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PRESSURE-TREATED WOOD

SPECIALIZED POWER from FAIRCHILD

JET POWER for a guided missile . . . take-off boost for a commercial or military transport . . . main power source for a piloted plane . . . these are potential uses for the Fairchild turbojet engines.

The J-44, now in production, was the first choice for the new high-speed, high-altitude Ryan Firebee target drone. This engine design, proving its worth *today*, has unlimited possibilities for *tomorrow*.

* * *

FAIRCHILD'S monocoque construction is another important development by an organization with over 25 years of power plant experience. Working for all three branches of the services, this development and production team is looking ahead to meet the challenge of *specialized power* on land, in the sea, and in the air.

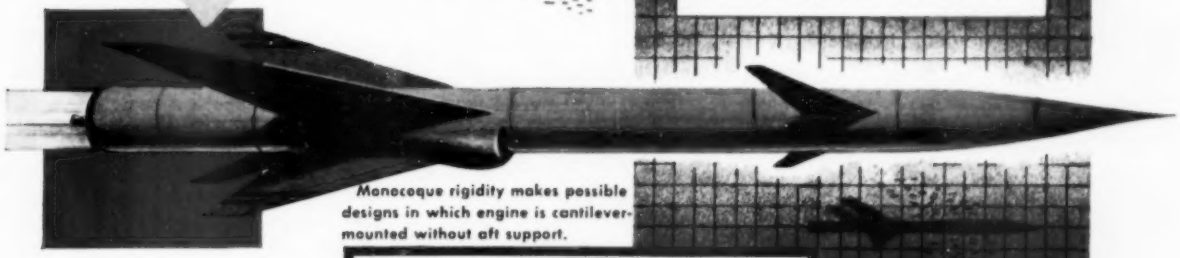
J-44 SPECIFICATIONS

Announced thrust	*1000 lbs*
Weight	*300 lbs*
Length	*72 inches*
Diameter	*22 inches*

PRODUCTION, with unique monocoque construction, minimizes heavy castings and machined parts, speeds up manufacturing.

OVERHAUL and service is simplified — shown are only tools required for complete assembly or dissembly.

INSTALLATION is simplified with removable accessory section, containing essential controls, fuel pump and electrical units.



Monocoque rigidity makes possible designs in which engine is cantilever-mounted without aft support.

ENGINE AND AIRPLANE CORPORATION

FAIRCHILD

Engine Division

Farmingdale, L.I., N.Y.

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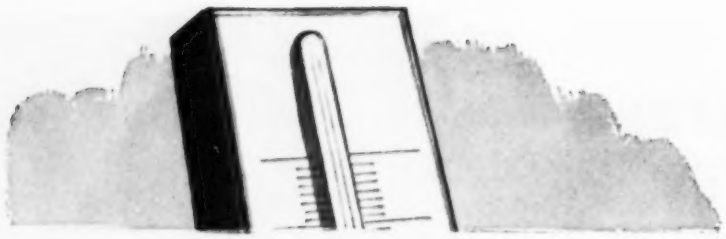
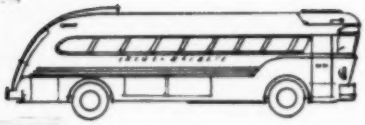
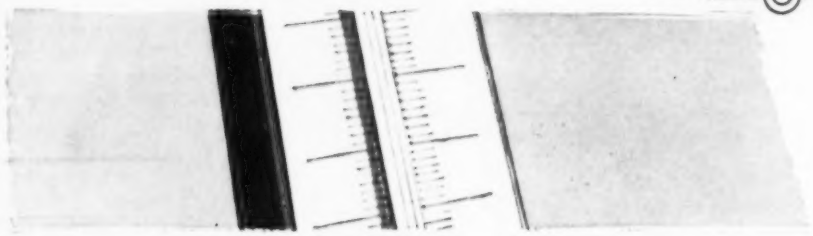
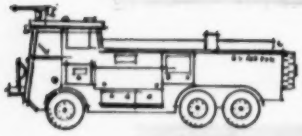


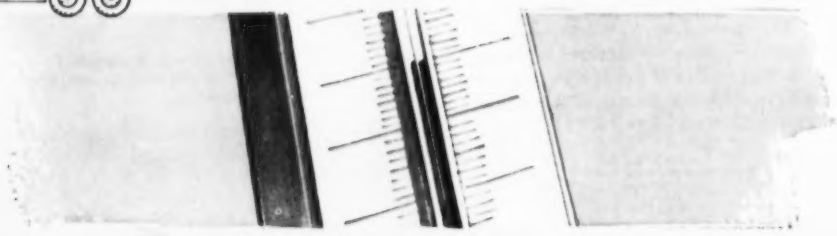
ALL-WEATHER



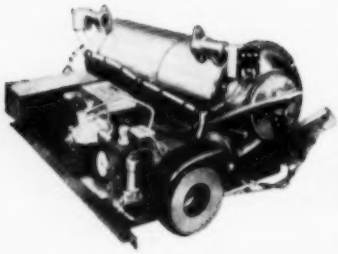




OPERATION ASSURED



with JANITROL LIQUID HEATERS



It's a cold hard fact that *reliable operation in any weather*—right down to 65° below zero—is a tough spec for any vehicle. But it's a requirement that can be met in full with Janitrol liquid heaters—as severe tests have proved repeatedly. On the USAF bomber tow tug built by Euclid Road Machinery Company, for example, positive starting was accomplished without special fuel capsules at –65°F after a 72-hour cold soak, and engine temperature jumped to the 155° to 165°F range well within 60 minutes.

If you're responsible for protecting investments in any vehicles or stationary engines or mobile power plants, gasoline or diesel powered, you'll do well to look into the 6-year long record of Janitrol liquid heater reliability. Your nearest Janitrol representative is always at your service.

HEAT WHEREVER YOU WANT IT

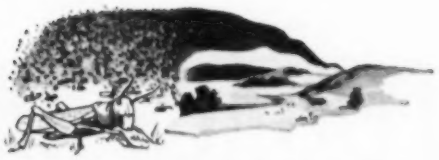
KNOWN THE WORLD 'ROUND

Janitrol

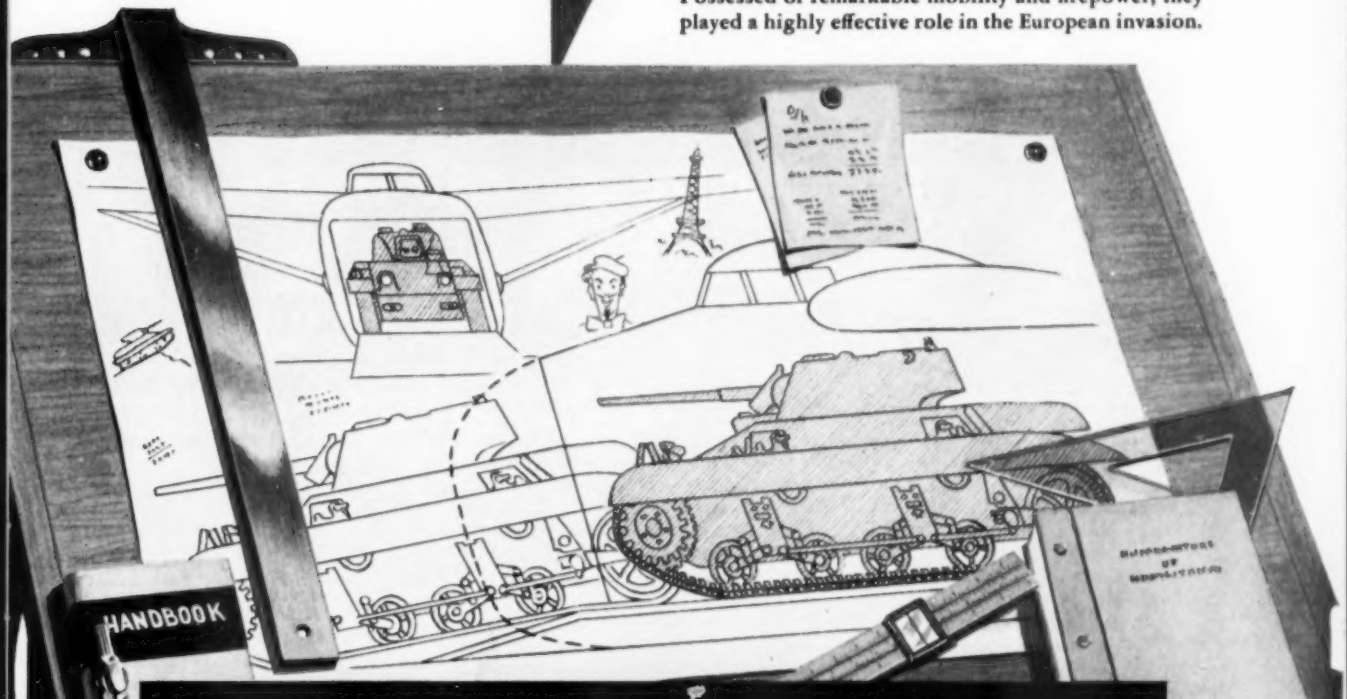
AIRCRAFT-AUTOMOTIVE DIVISION SURFACE COMBUSTION CORP., TOLEDO 1, OHIO

F. H. Scott, 225 Broadway, New York, N. Y. • C. B. Anderson, 2509 W. Berry St., Ft. Worth, Tex. • L. A. Curtin, 7046 Hollywood Blvd., Hollywood, Calif. • F. H. Scott 4650 East-West Highway, Washington, D. C. • Phil A. Miller; Frank Deak, USAF Coordinator, Central District Office, 400 Dublin Ave., Columbus, Ohio • Headquarters, Toledo, Ohio

IMAGINATION IN ACTION!



The "Locust" Developed in collaboration with Ordnance engineers, Marmon-Herrington built more than 1,000 "Locust" tanks during World War II. These were the world's first airborne tanks, designed specifically for surprise landings behind enemy lines. Possessed of remarkable mobility and firepower, they played a highly effective role in the European invasion.



● The "Locust" is but one of hundreds of examples of how Marmon-Herrington's engineering ingenuity has successfully solved some of the most vexing problems of military transport. No matter how difficult your own requirements may seem, if mechanization is involved, the chances are strong that Marmon-Herrington can help you find the right answer. Let's talk it over.

MARMON-HERRINGTON COMPANY, INC. • INDIANAPOLIS 7, INDIANA

MARMON-HERRINGTON

Military Mechanization is our specialty

MATERIALS-HANDLING NEWS

★ Panel Discussions by Bassick, World's Largest Manufacturer of Casters and Floor Protection Equipment ★

Are WALLFLOWER trucks costing you money?

If you're looking for ways to cut operating costs (and who isn't?), here's one that's often overlooked.

Check your rolling stock—dollies, hand trucks, portable equipment, etc.—and see whether you haven't got a few "wallflowers" that nobody wants to use. You'd be surprised how often equipment that seems to be in good shape stands on the sidelines because inefficient casters make them unpopular with workmen. Since they're hard to move, they get the cold shoulder in favor of equipment that rolls easily and smoothly. And it's no news that idle equipment wastes money fast.

You can make the "wallflowers" carry their full share of the load simply by equipping them with efficient Bassick casters. Why not try Bassick casters on one of your idle trucks? Then watch how quickly it goes to work for you.

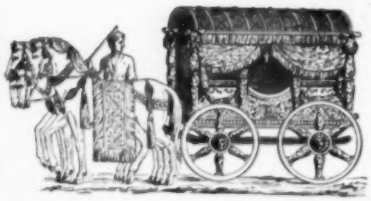
Put them back in ACTION with these Bassick Casters

SERIES "L99" SERIES "H99" SERIES "S99"

These rugged Bassick truck casters make any floor an "Easy Street" for portable equipment. Built to give easier handling and longer life, they come in sizes from 3″ to 10″, with all types of wheels, have fully hardened raceways.

There's a Bassick industrial caster distributor in your neighborhood who stocks the right size and type of caster for anything from teatables to ten-ton trucks.

Why Roman roads are arrow-straight



Engineers who marvel at the enduring construction of the old Roman roads sometimes conclude that they're straight as an arrow because that's the best way to build military vehicular highways in a hurry. Some historians offer another explanation. They think these roads are straight because the Romans hadn't discovered the trick of swiveling the wheels of their 4-wheeled carts. Naturally these had a hard time getting around corners, while the famous Roman chariots simply skidded around on their two wheels.

This may also explain why the Romans built so many 2-wheeled state coaches when you'd expect them to have four wheels. An exception is the ornate carriage shown above, which is of uncertain date.

Good casters do not need straight roads. They provide the flexibility so important in materials handling to move any equipment immediately in any direction. Put your loads on Bassick Casters and save precious time and labor. Bassick has the right caster for the job.

THE BASSICK COMPANY
Bridgeport 2, Conn.
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Bassick
A DIVISION OF
STEWART SW WARNER

MAKING MORE KINDS OF CASTERS MAKING CASTERS DO MORE

★★★★★ **for domestic or export shipment...**

★★★★★ **for light or heavy products...**

★★★★★ **for large or small objects...**

there's a General engineered shipping container to meet military packing needs!

Pictured here is a General Wirebound box for the export shipment of 50-caliber ammunition. It combines strength and light weight. It is one of many types made by General —to meet military needs. Remember General when you have a military packaging problem. Container experts will be glad to design a package for your product, or help you with various specifications.

Write for your FREE *Copy of "The General Box." It shows how to cut packing and shipping costs.*

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DISTRICT OFFICES AND FACTORIES: Cincinnati, Denville, N. J., Detroit, East St. Louis, Kansas City, Louisville, Milwaukee, Sheboygan, Winchendon, General Box Company of Mississippi, Meridian, Miss., Continental Box Company, Inc., Houston, Dallas

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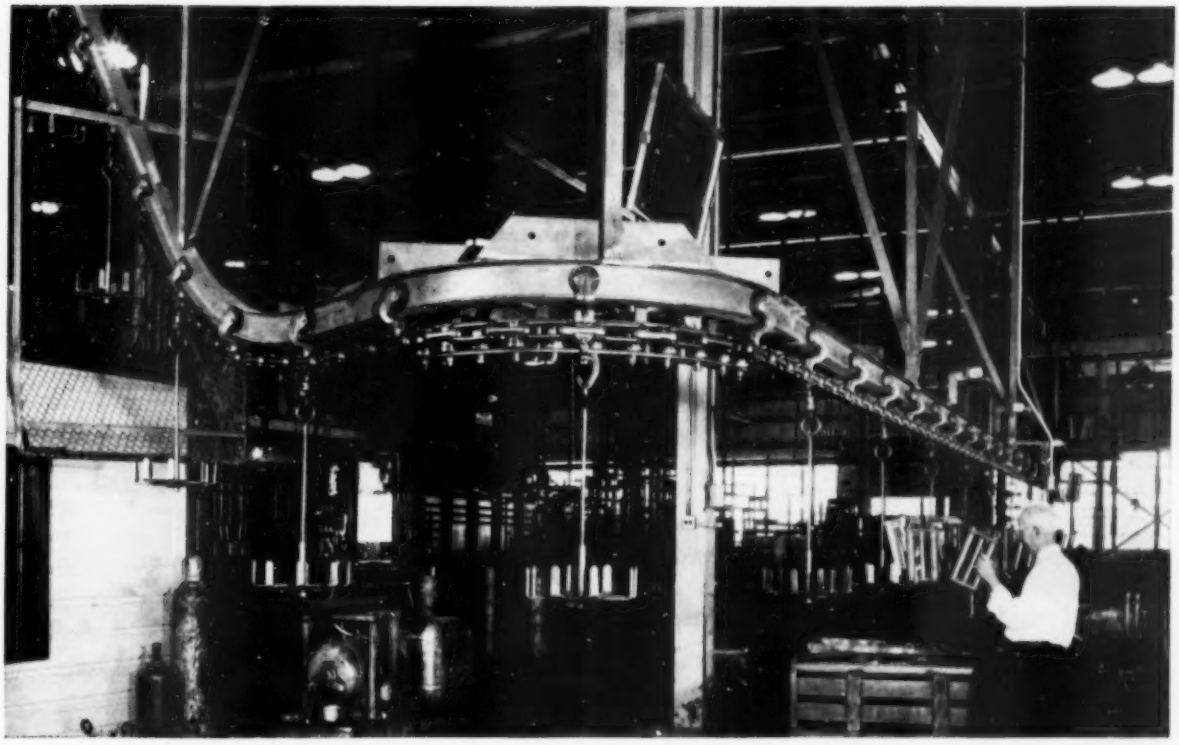
THE STEEL PRODUCTS ENGINEERING CO.

ENGINEERS AND MANUFACTURERS • SPRINGFIELD, OHIO

How one Link-Belt Overhead Trolley Conveyor coordinates eight production operations



Link-Belt Overhead Trolley Conveyor makes 120° curve after descending to working level. Part assembly stations are at right.

LINK-BELT engineered system increases output per manhour 33%

How would you coordinate movement of parts to and from five furnaces and three assembly stations, each operating at different capacities? Here's what one company did:

They installed an 856 ft. Link-Belt Overhead Trolley Conveyor system. Immediately efficiency so improved that production became limited only by furnace speed. Valuable manpower was released for skilled tasks . . . floor space previously needed for parts storage was utilized for productive operations.

If materials move along a fixed route in your plant, Link-Belt Overhead Trolley Conveyors may offer similar benefits for you. Material can be moved upward, downward, to either side . . . kept close to the ceiling where headroom is required or lowered to bring it down to a working area. To learn what can be done to increase production in your plant, consult a Link-Belt engineer. Simply call your nearest Link-Belt office for expert, experienced assistance.

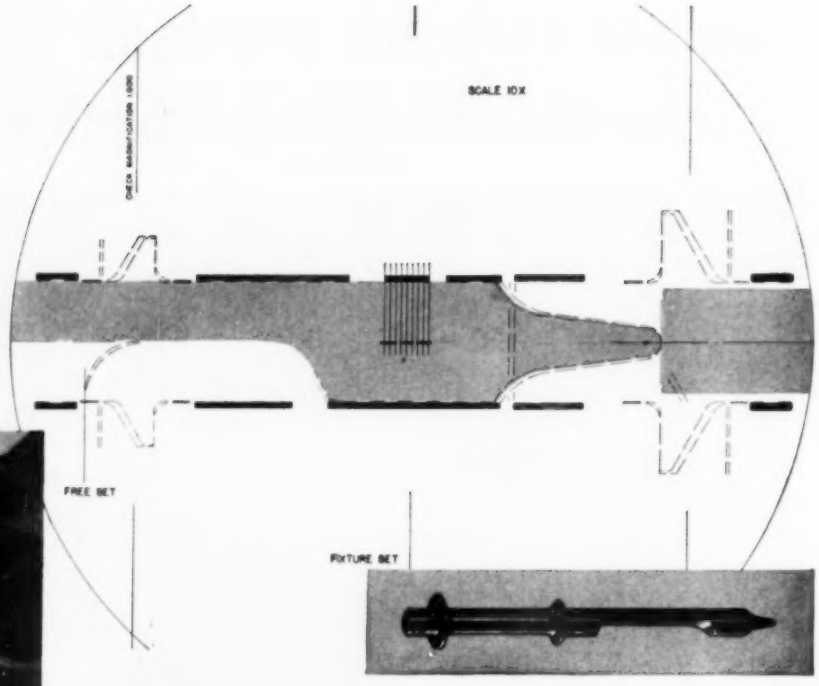
Conveyor takes 180° turn prior to bringing parts to two of the furnaces. Note spring type corner idler take-up. Building-to-building movement is also coordinated by this system.

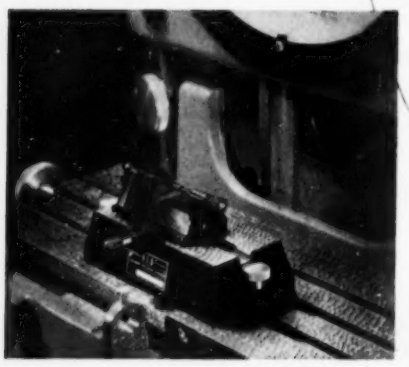
LINK-BELT

OVERHEAD TROLLEY CONVEYORS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,271

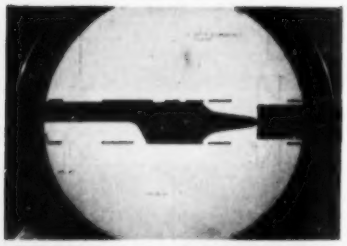
The heavy lines on the Chart-Gage have indentations forming slits of light when the part is within tolerance. If the part is undersized, light is seen under the entire line. If oversized, no light is seen. Only a quick glance is necessary to check tolerances. Experienced help is not required.

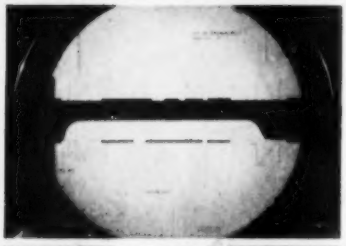


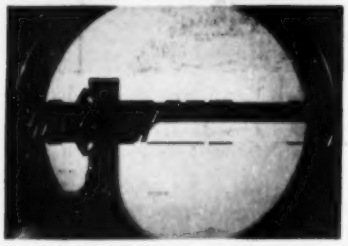


26 DIMENSIONS...

checked in 60 seconds







The above photographs show the image of the part in the three inspection positions. The same "composite" Chart-Gage is used for all three.

The firing pin illustrated above has 26 critical dimensions. Yet, by Optical Projection Gaging, the entire inspection takes less than 60 seconds—a fraction of the time and costs required with mechanical gages.

The part is mounted in a fixture on the stage of a Kodak Contour Projector. Its image, magnified 10 times, is projected on the screen and compared with a Chart-Gage. Although the image of the 3½″ part is 35″ in length, the entire part is checked on the 14″ diameter screen by means of indexing the part in the fixture. The entire procedure requires less time than it would take to merely handle the gages ordinarily used.

Perhaps you can realize similar savings in inspection costs through Optical Projection Gaging, as so many industries and government facilities have. To find out, send sample parts and specification prints for our analysis, or write and have our local representative contact you for a personal conference.

OPTICAL GAGING PRODUCTS INC.

SUCCESSORS TO ENGINEERS SPECIALTIES DIVISION OF UNIVERSAL ENGRAVING AND COLORPLATE CO., INC.

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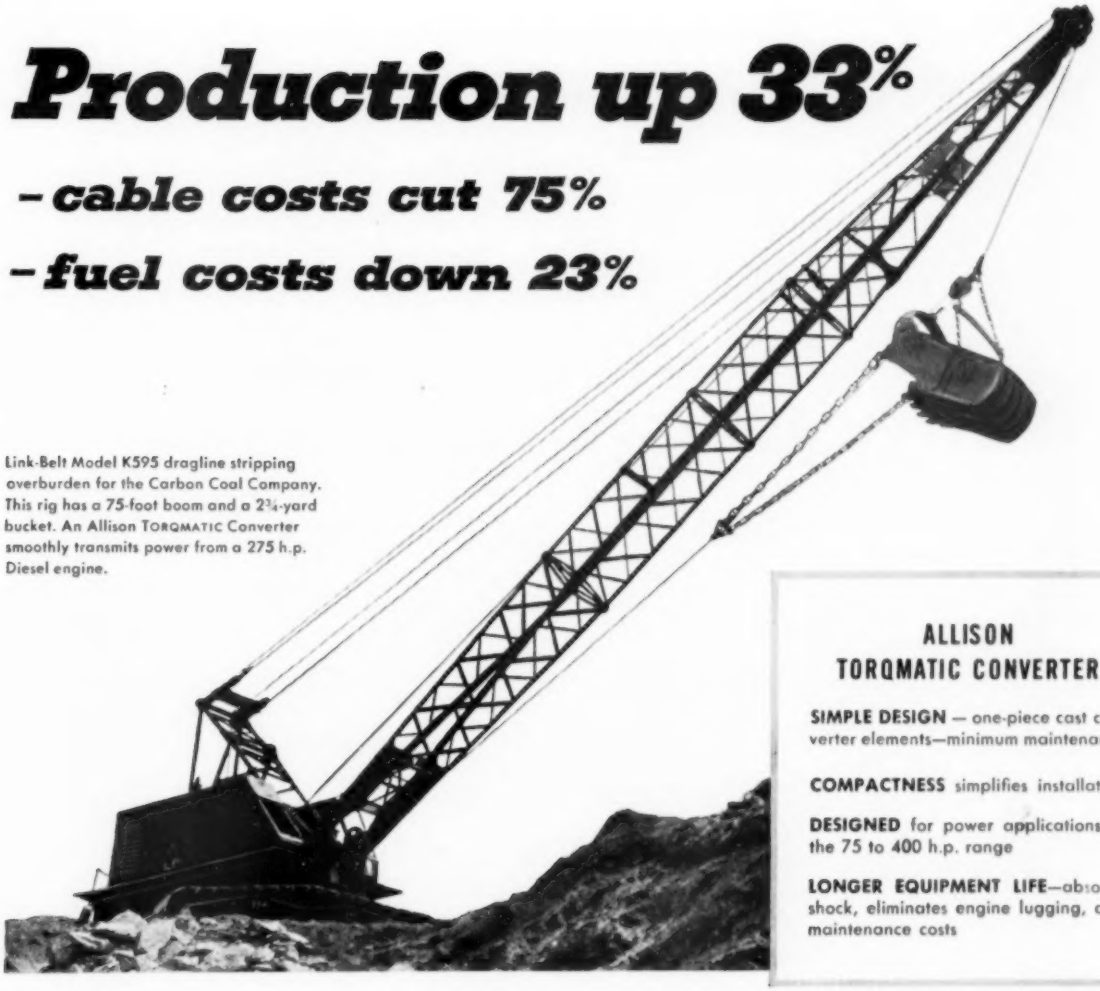
SPECIALISTS IN PROJECTION GAGING

Production up 33%

– cable costs cut 75%

– fuel costs down 23%



Link-Belt Model K595 dragline stripping overburden for the Carbon Coal Company. This rig has a 75-foot boom and a 2¾-yard bucket. An Allison TORQMATIC Converter smoothly transmits power from a 275 h.p. Diesel engine.

ALLISON TORQMATIC CONVERTER

SIMPLE DESIGN — one-piece cast converter elements—minimum maintenance

COMPACTNESS simplifies installation

DESIGNED for power applications in the 75 to 400 h.p. range

LONGER EQUIPMENT LIFE—absorbs shock, eliminates engine lugging, cuts maintenance costs

Here's another operator who's boosting production and cutting costs with Allison TORQMATIC DRIVES: The Carbon Coal Company operates two Link-Belt draglines, strip-mining coal near Grove City, Pa. The units are nearly identical—one has an Allison TORQMATIC Converter, the other is direct-driven—but there's a big difference in operating costs and production.

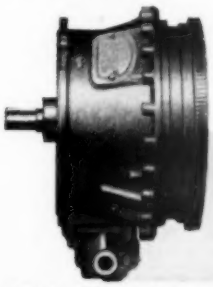
The Allison Converter absorbs shock loads so dragline cable on the TORQMATIC-equipped unit lasts four times as long, *saving $2160 a year on cable alone,* a reduction of 75%.

The TORQMATIC-equipped unit strips a 60x40x25 foot "lift" of overburden in 24 hours against 32 hours for the direct-driven unit, a 33% increase in production. A comparison of daily fuel records shows the friction drive unit consumes 130 gallons while the Converter-equipped unit uses only 100 gallons, a cut in fuel costs of 23%.

The TORQMATIC-equipped unit has rolled up such an impressive performance record that this operator intends to specify TORQMATIC DRIVES in all his new heavy-duty equipment. You, too, can cut your costs by specifying Allison TORQMATIC DRIVES the next time you buy. Ask your equipment dealer, manufacturer or write:

ALLISON DIVISION OF GENERAL MOTORS

Box 89400, Indianapolis 6, Indiana



Allison **TORQMATIC DRIVES**

GM GENERAL MOTORS

COMPACT, EFFICIENT HYDRAULIC DRIVES FOR CRANES * TRUCKS * TRACTORS * SCRAPERS * SHOVELS * DRILLING RIGS

Three Reasons Why
We Have Always Met Deliveries
In World War II and Since Korea
1. A plant built especially to make military pyrotechnics and load ammunition . . . and nothing else.
2. A staff of specialists in every phase of design, tooling and manufacture of military pyrotechnics and ammunition.
3. Intelligent native workmen trained to produce safely, efficiently and consistently.
Our operations are not a partial reconversion, not a sideline to some other business. For over 13 years our organization and facilities have been devoted solely to the design and production of military pyrotechnics and ammunition.
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AERIAL PRODUCTS, Inc.
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FLARE AND SIGNAL MUNITIONS • SHELL AND FUSE LOADING
DETONATOR AND BURSTER COMPONENTS FOR AMMUNITION
DISTRESS SIGNALS • HAND-HELD ROCKETS

Remington Rand Methods News

KEEPING A FINGER ON 12,000 ITEMS: For an over-all cost of 12½ clerical units, National Motor Bearing keeps accurate, centralized control of 12,000 different items in 7 plants and warehouses. This battery of automatic machines also simplifies payroll procedures and produces reports for analyzing all sales.

Money-saving short cuts in Production, Distribution and Accounting!

We wish you could talk with the Production and Sales people at National Motor Bearing Co. What they say about their new punched-card system makes mighty profitable listening. For example:

Cost Analysis: It used to take 30 days after the job was completed to get even the sketchiest information. Now high-speed punched-card machines have *complete,* accurate facts ready in *just 5 days!*

Inventory Control: National Motor Bearing's inventory turns over *fourteen times a year!* To get fast, up-to-date facts about 12,000 different items in 7 plants and warehouses, they use high-speed punched-card accounting. Old methods used to mean shortages, back orders, even lost orders. Today, N.M.B. inventory is better than *99% accurate!*

Production Control, Payroll Procedures: National Motor Bearings discovered that punched cards brought them amazing savings in time and money. These high speed automatic machines can give executives complete *daily* production reports. What's more, payroll procedures, are as a by-product, simplified and much faster.

We have prepared a complete Certified Report which gives you all the facts and figures of punched-card accounting at N.M.B. For your copy circle **CR752** at the bottom of the page and mail coupon today.

Stop trouble before it starts!

Your Preventive Maintenance Control must help catch breakdowns before they happen – OR ELSE!

Maintenance Executives, who have a hearty dislike of paperwork, always like our simplified visible systems. There's no confusion, little or no detail work. These visible records: (1) signal the inspection date, (2) permit scheduling of work ahead, (3) pinpoint location of equipment, (4) chart depreciation.

Let us show you how Preventive Maintenance Control can help prevent breakdowns... keeps your plant equipment humming. Simply check **KD705** at the right and drop the coupon in the mail.

Why operate a Personnel Department the hard way?

Let our manual of personnel administration record keeping show you money-saving short cuts you can take. This manual shows how specific skills can quickly be located. It tells how to answer 80% of all Personnel Department phone calls – in mere seconds. It points out how you can maintain control over punctuality, vacations, etc. And it gives you examples of other profitable Personnel Department procedures. Ask for **X521.**

No chance for error!

How do *you* process customer orders? Typing a master copy for duplicating is one way to begin, but even the most expert typists make errors–and duplicating does take time.

Moog Industries, Inc., of St. Louis discovered that our photocopy equipment speeds up order processing like magic... assures 100% accuracy. For the complete photocopy story at Moog Industries and how it can be used efficiently by your firm, ask for **CR856.**

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3-14

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We've wired the Little Red Schoolhouse for SOUND

The American schoolhouse isn't little any more. And its need for fast intercommunication has grown as rapidly as its rooms and its enrollment.

Yesterday's "communication" was pretty much limited to teachers sending pupils scurrying on errands. Today, anyone in the school, from class president to principal, can man the mike—supervise high fidelity record-playing—*use the network of intercom telephones*—or send and direct programs and announcements to any or all of 60 stations!

School assemblies no longer mean a mad rush to the auditorium; instead, a thousand children sit in their rooms and listen. High fidelity radio programs and recorded music, announcements, and television educational features can be received in every room or in any selected few. And the advantages of such a service in fire drills or in Civil Defense practice is both obvious and imperative.

We make these Systems. We have them in service from coast to coast. Their engineering may seem complex to the layman. It's just second nature to this pioneering company which has been in the forefront of communications since the days of McGuffey's Reader!

There is nothing finer than a

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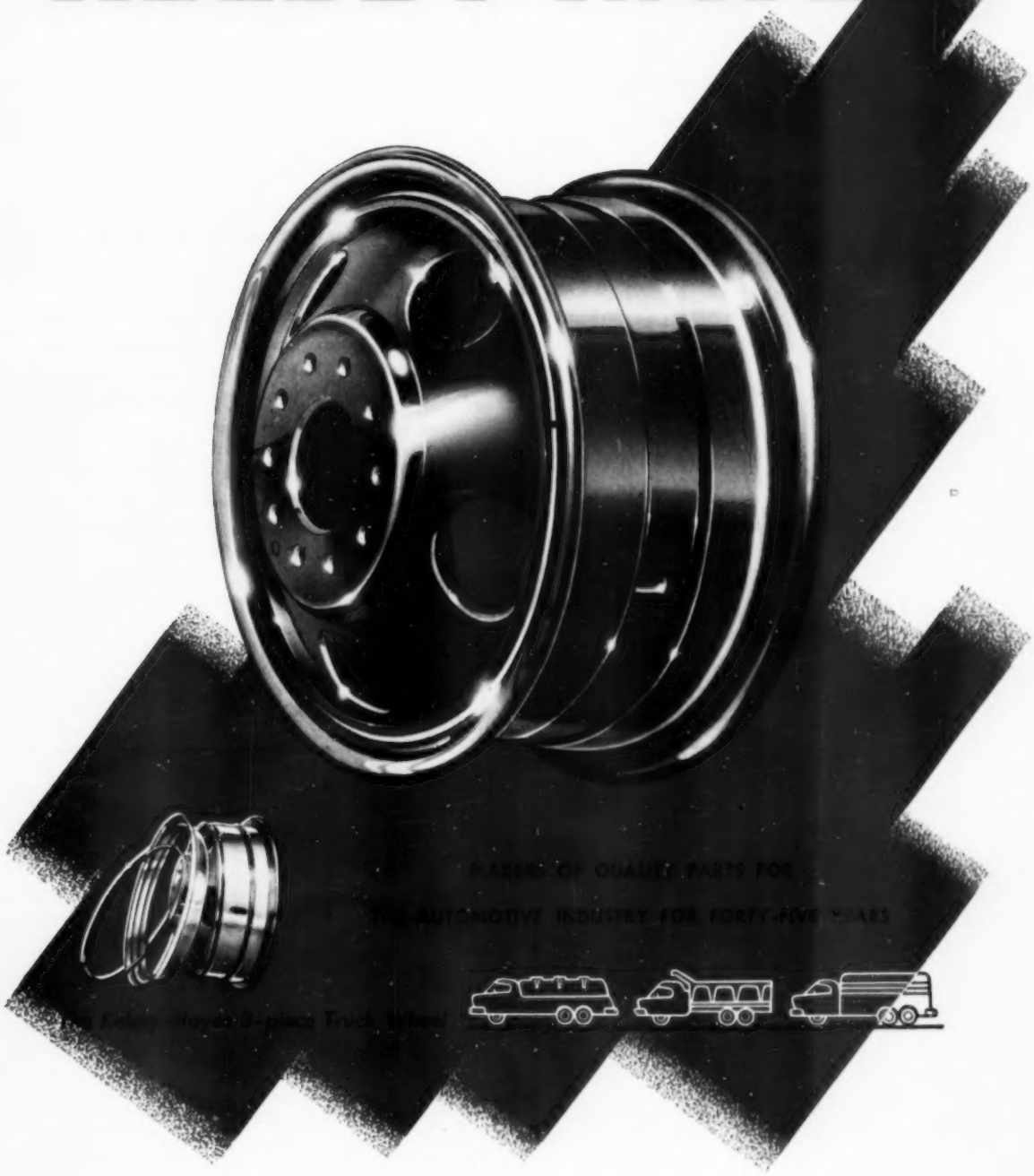
KELSEY-HAYES



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DURABLE . . .
stands up under abuse

We may be stretching it a lot when we suggest this type of abuse . . . but it's no exaggeration to say "Kreolite" Wood Block Floors take the punishment of massive weights, savage blows and grinding wheels as long as the factory stands.

Coated with "Kreolite Jennite", it is a comfortable floor to work and walk on because it absorbs noise and vibration . . . is dust-skid-and-spark-proof . . . is cooler in summer and warmer in winter.
A Jennison-Wright flooring expert will call at your request.

SPECIFY KREOLITE . . . *Hundreds of millions of square feet used by leading industries since 1911*

1 Comfortable to Work Over
2 Durable-Stand Up Under Abuse
3 Protect Dropped Tools and Parts
4 Quick to Install—Easy to Replace
5 A Firm Foundation for Machines
6 Absorb Noise-Cut Down Vibration
7 Insulate Against Heat and Cold
8 Spark-Proof, Skid-Proof, Safe*
9 Provide for Conduits and Cables
10 Dustless-Easy to Clean
11 Good for Trucking Aisles
12 Lowest Maintenance Cost

**A "Kreolite" Wood Block Floor is cleaner and better when given a coating of Kreolite Jennite, our proven exclusive final filler and finish that does not become tacky.*

KREOLITE WOOD BLOCK FLOORS

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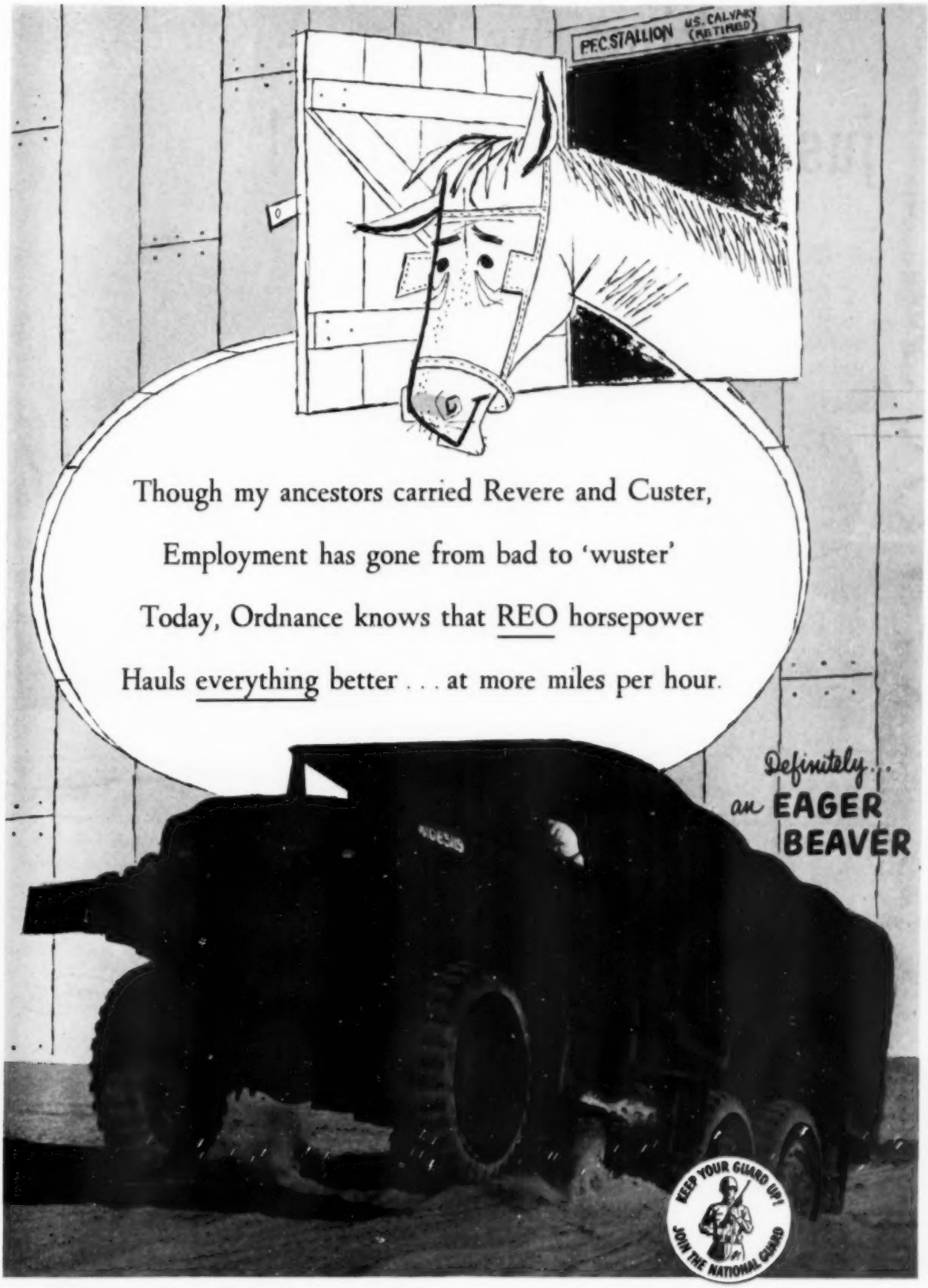
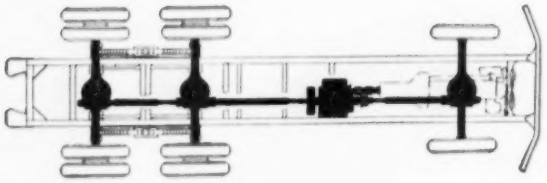

PEGSTALLION U.S. CALVARY (RETIRED)
Though my ancestors carried Revere and Custer,
Employment has gone from bad to 'wuster'
Today, Ordnance knows that REO horsepower
Hauls everything better . . . at more miles per hour.
Definitely . . . an EAGER BEAVER
KEEP YOUR GUARD UP!
JOIN THE NATIONAL GUARD

REO MOTORS, INC. • Lansing 20, Michigan

Making the best just a little bit better!



↑ Side view—New TDA Straight-Line Drive

← Top view—New TDA Straight-Line Drive

LOOK UNDER THE TRUCK FOR MAJOR IMPROVEMENTS!

Realizing that today's "best" is often obsolete tomorrow, TDA is constantly developing new improvements in military truck axle design and construction. For instance, TDA'S new Straight-Line Drive for the "Eager Beaver" 2½-ton 6x6 military truck has improved performance under all load, road and speed conditions.

This new design (shown above) features a straight-line drive from the front axle through the transfer case to *both* rear axles. This is possible because top-mounted double-reduction final drives are used in all *three* axles. Not only is ground clearance increased, but propeller shaft angles are reduced both vertically and horizontally. In addition, parts interchangeability is greatly increased.

Since World War I, TDA has been working in close co-operation with the Armed Services to "improve the best." This never-satisfied attitude today will mean ever finer vehicles tomorrow.

The Accepted TDA Standard

AXLES

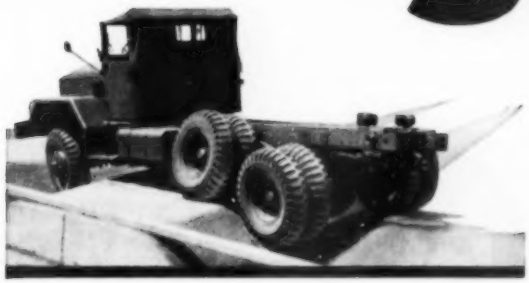
THE TIMKEN-DETROIT AXLE COMPANY
DETROIT 32, MICHIGAN

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

PLANTS AT: DETROIT AND JACKSON, MICH. • OSHKOSH, WIS. • UTICA, N. Y. • ASHTABULA, KENTON AND NEWARK, OHIO • NEW CASTLE, PA.

flexibility

Flexibility to meet the demands of any military situation . . . flexibility to travel any terrain without power loss – that's the performance International Harvester builds into 5-ton trucks for the Armed Forces.



The same engineering, research and manufacturing know-how that have built our reputation for quality, also stand behind our military production. Rigid tests conducted at International Harvester proving grounds in Fort Wayne, Indiana and at Phoenix, Arizona *prove that production!* We know these trucks have extra power and sturdiness always on the ready.

The twist course, putting an International 5-ton 6 x 6 through the paces, is only one of many tests used to determine the amount of punishment these trucks can take. Internationals are proved before they start . . . will set the pace wherever, whenever duty calls.

INTERNATIONAL HARVESTER Chicago 1, Illinois

Builders of products that pay for themselves in use . . .
International Trucks • McCormick Farm Equipment and Farmall Tractors
Crawler Tractors and Power Units • Refrigerators and Freezers

★ PRODUCING FOR DEFENSE ★

For the design and production of complex electro-mechanical devices, why not take advantage of the experience and competence AC has attained in the development and manufacture of such highly technical equipment.

GM GENERAL MOTORS

AC KNOW HOW

GM GOOD MANAGEMENT

DEFENSE PRODUCTS

of High Quality at Low Cost

DELIVERED ON TIME

Now producing a number of complex, high precision electro-mechanical devices for the Armed Forces such as . . . A-series Gun-Bomb-Rocket sights, A-1A Bombing Navigational Computers and T-38 Skysweeper Fire Control Systems.

★

700 Graduate engineers, scientists and technicians.

★

3 Plants — 3 Million square feet of floor space — 17,000 employees. More than 35,000 machine tools, representing practically every phase of the machine tool industry.

★

Comprehensive field training set-up for military and civilian personnel.

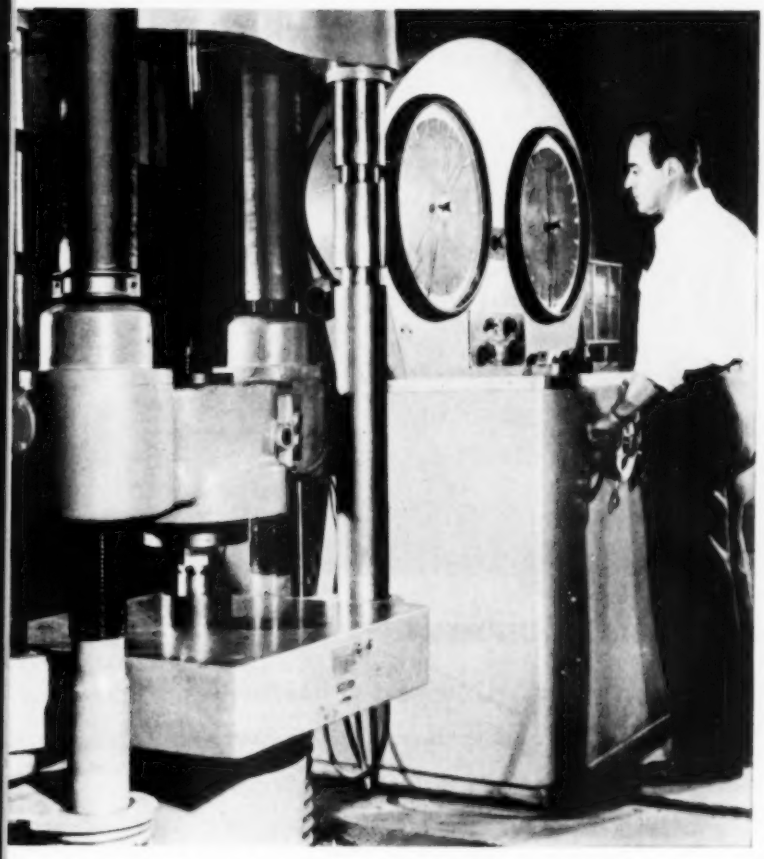
★

A sub-contracting network of dependable and efficient manufacturers.

★ AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION • FLINT, MICHIGAN ★

Research points the way...

TO BETTER PERFORMANCE

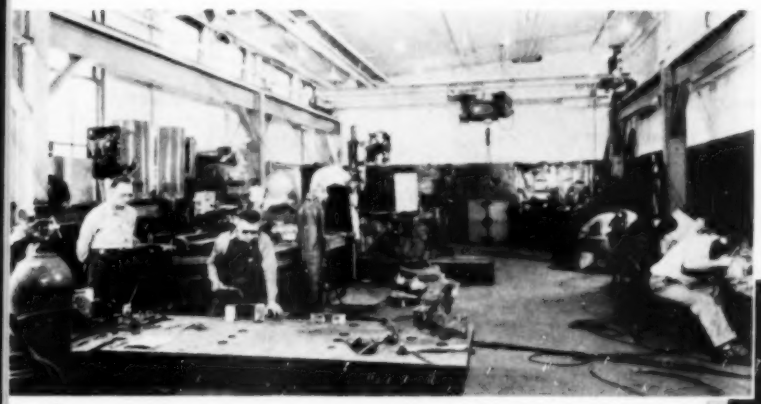


This 200,000-lb. capacity hydraulic tester tells whether a part will take the stresses and strains of tough operation and still assure a wide margin of safety.

Dependable, on-the-job performance of Allis-Chalmers equipment is pre-determined. Behind every finished product are years of scientific research followed by more years of torture tests, both at the Company proving grounds and under actual job conditions.

In many physics, chemical, electrical and metallurgical laboratories, occupying four floors of the Allis-Chalmers Research Building, is a large staff of scientists and technicians. This staff is constantly probing for better materials for a given job as well as for methods of building a better product. In addition, constant spot checks of materials in production assure continued high quality of the finished product. In 1952 alone, the Allis-Chalmers Research Department conducted a total of 266,777 tests.

This policy of scientific search for improvement will continue, for Allis-Chalmers believes that research provides the fundamental scientific data on which better products are built.



▲ In a well equipped welding laboratory, Allis-Chalmers technicians are constantly developing new techniques . . . testing new supplies and equipment. After studies are made in this laboratory, methods and materials which prove to be better are recommended for use in manufacturing.

This X-ray diffraction equipment determines in what form or combination elements occur in certain materials used in manufacturing. Further tests tell which of these forms function best in actual service. ▼

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Another Example of Beaird Manufacturing Skill

ANHYDROUS AMMONIA EQUIPMENT

The introduction of anhydrous ammonia as fertilizer, in 1947, brought to American agriculture an entirely new source of nitrogen. But this liquid fertilizer, which contains over 80% nitrogen, requires special equipment for handling and application. So Beaird engineers tackled the problem, working closely with the ammonia industry, and developed a full line of pressure storage and applicator tanks. Now Beaird anhydrous ammonia equipment may be found in use throughout a twenty-eight state area.

THIRTY-FIVE YEARS EXPERIENCE in manufacturing a wide variety of products has made Beaird unusually well equipped to handle large production orders of ordnance materials.

Central location near Southwest ports *Experienced engineering staff* *Ample supply of Skilled labor*
Trained inspection department *Modern manufacturing facilities*

SINCE 1918 BEAIRD SHREVEPORT
MACHINING FABRICATING STEEL WAREHOUSE

THE J. B. BEAIRD COMPANY, INC. Shreveport, Louisiana

PACKAGED COMPRESSOR PLANTS | LP GAS SYSTEMS | CAST STEEL FITTINGS | ANHYDROUS AMMONIA EQUIPMENT | PRESSURE BULK STORAGE

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invite
you to ask
any
Olin
customer
about
Olin
quality
...whether
it
be a
manufacturer
who buys
Western Brass
or a
small boy
so proud
to own
a genuine
Winchester
22 rifle

Arms and Ammunition
Ecusta Paper
Metals
Explosives
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headquarters
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Cutters that
give you
More Clean Cuts
Per Dollar
Every cutter in the broad Brown & Sharpe line is carefully designed and manufactured to lower your *real* cutter cost . . . give you more smooth, clean cuts per dollar invested. Complete selection of types and sizes to improve milling efficiency on any job. Write for illustrated Catalog. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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MEMORANDUM

To: Ordnance Engineering Officers

From: Gear Specialists

Subject: Solution to Gearing Problems

For more than 50 years our engineer-specialists have successfully met and solved problems in the design and application of high precision gears.

This invaluable experience is available to you, either on a consultation basis when you need an 'engineering assist' – or, in the form of Fellows equipment best suited to your needs of cutting, finishing and testing gears for all branches of the service.

If currently faced with a gearing problem, a call or letter will bring a Representative. No obligation, of course.

Fellows

THE FELLOWS GEAR SHAPER COMPANY

Head Office & Export Dept.: 78 River St., Springfield, Vermont. Branch Offices: 323 Fisher Bldg., Detroit 2 • 5835 West North Avenue, Chicago 39 • 2206 Empire State Bldg., New York 1.

★Move Pallets More Efficiently with Alvey-Ferguson Conveyors!

HERE'S the efficient way to move loaded pallets from floor to floor. Photograph at left shows an A-F Loading Conveyor on which loaded pallets are placed by lift trucks. When operator switches on current, pallet is conveyed to conveying carrier at rear (see photo at right), then carried to floor above, where pallet is conveyed out to lift truck. Operation, automatically controlled by limit switches, may be reversed. For most recent information, or a discussion on conveying products or ordnance materials in plants, arsenals or storage—write today.

THE ALVEY-FERGUSON CO.
534 Disney St. Cincinnati 9, Ohio
First in the Conveyor Industry—Since 1901

CONVEYING EQUIPMENT
Alvey-Ferguson
METAL PRODUCTS CLEANING EQUIPMENT

POUR yourself a BRIGHT, NEW FLOOR with *NEW* FULLER LIQUID WAX

Direct from Us to You

FULLTRED FLOOR WAX

For those "danger spots" where you need extra anti-slip protection.

FULLUSTRE Self-Polishing FLOOR WAX

To get a brilliant lustre without hard work or buffing, get Fullustre.

FREE

Illustrated folder, "Experience is Part of the Product", gives you the "inside" on the complete Fuller chemical line. Send for your copy today!

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SOLD
GUARANTEED
BY

Fuller BRUSH CO

INDUSTRIAL DIVISION
3585 Main Street
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SHADOGRAPH'S New Center Tower Scale . . .

THERE IS NO SUBSTITUTE FOR EXACT WEIGHT

We announce a new addition to the already famous Shadograph models, the newly designed center tower type with all the features of previous models with these added improvements (1) commodity platter on one side of tower and counterweight platter on the other side (2) beam and poise mounted in front for easy, quick weight changes. All new models use the reflected shadow type of weight indication . . . all mechanical indication is eliminated and frictionless indication is produced. Five models in various capacity ranges are available starting from 50 grams, with a sensitivity of 10 milligrams to 1500 grams with sensitivity of 350 milligrams. Write for full details covering models to fit your operations.

EXACT WEIGHT SCALES

BETTER QUALITY CONTROL
BETTER COST CONTROL

THE EXACT WEIGHT SCALE COMPANY
900 W. Fifth Avenue, COLUMBUS 8, OHIO

MM MINNEAPOLIS MOLINE MODERN MACHINERY

INDUSTRIAL WHEELERS

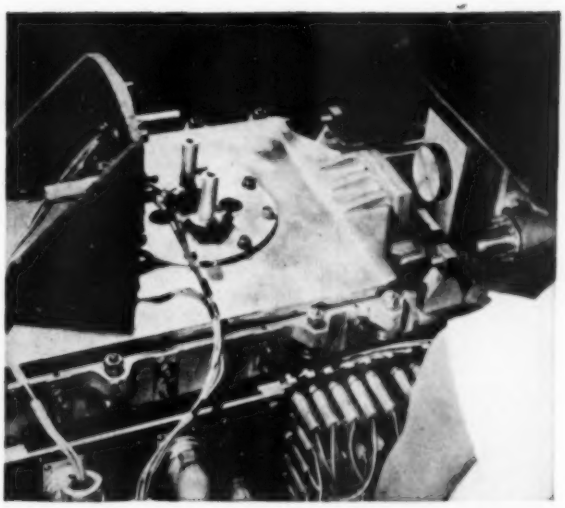
for material handling or equipment

27 hp and 51 hp max. developed engine hp Models

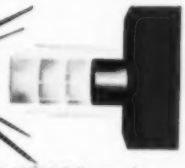
Manufacturing and processing plants use Minneapolis-Moline heavy duty wheel tractors on unusual yard handling operations. A wide selection of attached tools is available for moving bulk or palletized material with small investment.

Manufacturers also use MM wheelers to mount graders, stevedore cranes, revolving cranes, and sweepers. Specifications available on request or ask for recommendation for your product. Engineering service available.

MINNEAPOLIS-MOLINE
MINNEAPOLIS 1, MINNESOTA



Wham-O



Four TUNG-SOL ELECTRON TUBES receive a terrific jolt as a heavy steel battering ram smashes against the movable table on which they are mounted. Each tube is in a different position to determine stability in all directions. With an acceleration up to one thousand times the pull of gravity, this machine can give tubes a wicked beating.

Vigorous Quality Control procedures such as this give Tung-Sol Tubes the exceptionally high degree of uniformity preferred by the armed services. Quality Control is a whole series of exacting tests and inspections which point the way to better, more dependable tubes—sturdier both mechanically and electrically.

Tung-Sol Tubes for radio, TV and special industrial applications means top performance, longer and more efficient service life, plus lowest maintenance. You'll find complete satisfaction with Tung-Sol Tubes and Tung-Sol Service.

Write for sales or engineering information.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.
Sales Offices: Atlanta • Chicago • Columbus
Culver City (Los Angeles) • Dallas • Denver
Detroit • Newark • Seattle

TUNG-SOL®
ELECTRON TUBES
for Reliable Service

TUNG-SOL makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

ARE DRIVERS "RAILROADING" YOUR VEHICLES?

Handy Governors Will Stop It

Any driver is likely to be less than meticulous in his care of a vehicle he doesn't own. Many feel no compunction about "railroading" your vehicles. Drivers do most of their work away from supervision . . . abuses are hard to correct.

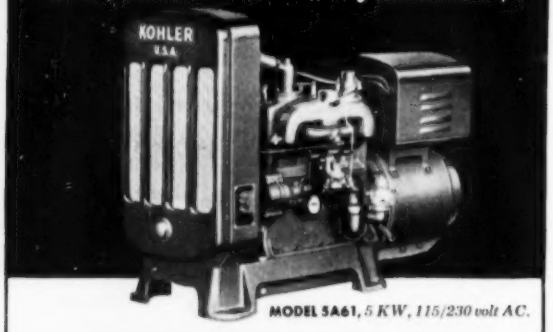
Handy Governor will stop "railroading"—stop practices which run up costs and wear out vehicles before their time.

The savings in tire, fuel, and lubricant costs, engine repairs, brake maintenance and general maintenance are spectacular. Reduced accident and insurance costs are equally important.

Let us show you some figures on savings—and tell you how little it costs to get them.

KING-SEELEY CORPORATION
ANN ARBOR, MICHIGAN
PLANTS AT ANN ARBOR, SCIO, YPSILANTI

KOHLER
ELECTRIC PLANTS
Independent Source of Electricity



MODEL 5A61, *5 KW, 115/230 volt AC.*

Kohler Electric Plants provide a portable, mobile, reliable source of light and power for military needs. Sizes range from 500 watts to 30 KW. Stand-by models available for emergency service. Write for folder 10-M.

Kohler Co., Kohler, Wisconsin. Established 1873

KOHLER OF KOHLER

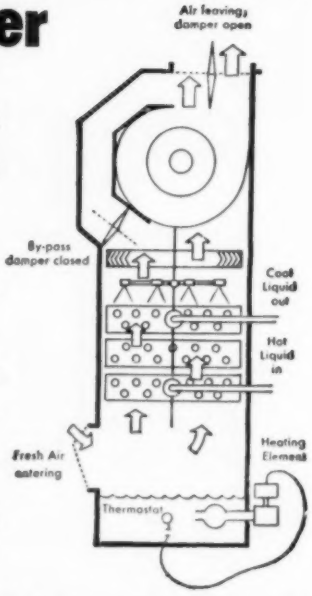
PLUMBING FIXTURES • HEATING EQUIPMENT • ELECTRIC PLANTS
AIR-COOLED ENGINES • PRECISION CONTROLS

NIAGARA Aero Heat Exchanger

1. Extends quenching capacity without extra water or cooling tower.
2. Quickly pulls down heat at initial peak load of Quenching.
3. "Balanced Wet Bulb" Control holds quench bath at proper temperature, heating if needed to start after shut-down, and cools or heats by automatic control.
4. Saves cleaning expense as compared to cooling tower which picks up acids and fumes from air.

APPLICATIONS

Quench Oils
Cutting Oils
Lubricating Oils
Cooling Water



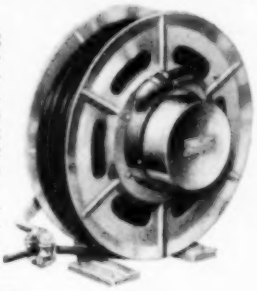
For help in increasing production, saving of cooling water, write for Bulletin No. 120. Address

NIAGARA BLOWER COMPANY
Over 35 Years of Service in Industrial Air Engineering

Dept. O, 405 Lexington Ave. New York 17, N. Y.
Experienced District Engineers in Principal Cities of U. S. and Canada.

NOW Faster, Easier Cable Handling

Spring-O-Matic



Improved ball-bearing, spring retractable POWEREEL handles up to 150' multiple conductor cable, sizes up to No. 4. Also for communications cable. Ratchet for stopping reel optional. Adjustable cable guide. Compact, easy to mount. Moisture and dustproof. Simple, easy cable installation. Cast aluminum reduces weight. *Also available for air and fluid hose.*

PORT-O-REEL

For long cords . . . sizes up to No. 12, 3-conductor. Has dust-tight collector ring, ball-bearing swivel base adjustable brake and lock on reel. Available with or without cord or hand lamp. Wt.—9 lbs. less cable and plugs. Reel 4" wide, 12" dia.

COLLECTOR RINGS

Many standard models in stock for immediate shipment. Designing and custom building to meet your special needs. Write or phone for engineering data on stock and special collector rings. Estimates on custom jobs gladly submitted.

We also make POWEREELS for heavy-duty cables, and specially engineered Torque-Motor Reels. If you have a special Reel or Collector Ring problem write or phone today.

INDUSTRIAL ELECTRICAL WORKS

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For nearly a half century

Kollmorgen has developed, designed and manufactured the following equipment for the Armed Services.

SUBMARINE PERISCOPES
NAVIGATIONAL INSTRUMENTS
FIRE-CONTROL DEVICES

KOLLMORGEN *Optical* **CORPORATION**

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New York Office: 30 Church St., New York 7, N.Y.

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wherever rubber, plastic or fabric hoses are used

RELIANCE "HOZ-FAS-NER"

will save you money

SQUEEZE OPEN AND SLIP ON HOSE — The one-piece design permits ease of application to normally situated hose connections or hard to reach places. Initial cost and ultimate savings reduce assembly costs.

MAKE CONNECTION — Reliance Hoz-Fas-Ners are manufactured from special spring steel to exacting specifications that automatically provide a constant uniform tightening action. They assure a perfect seal regardless of hose shrinkage or expansion.

PLACE IN POSITION AND RELEASE — The rounded surfaces of Reliance Hoz-Fas-Ners do not cut into hose material and because of their special finish are rust resistant . . . can produce economies for you.

WRITE FOR ENGINEERING BULLETIN NO. 1

EATON MANUFACTURING COMPANY

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Office and Plants: 510 Charles Ave., SE, Massillon, Ohio
Chicago • St. Louis • San Francisco • Montreal
Sales Offices: New York • Cleveland • Detroit

Why bore a hole when you can buy it?

SHELBY SEAMLESS STEEL TUBING

comes to you with the hole and basic shape already made!

IT costs money to bore a hole through solid stock. It takes time. It wears out tools. It wastes steel. In other words, it's poor economy.

By using Shelby Seamless Mechanical Tubing you can eliminate or greatly reduce many time and labor consuming operations connected with boring and machining.

Shelby Seamless Tubing is available in a complete range of sizes; in different wall thicknesses; various finishes and steel analyses . . . with the basic shape already made . . . and with the hole built in.

Another important advantage in using Shelby Tubing is that its excellent machining characteristics and uniformity speed up production and improve the quality of your output. You can turn out parts by the millions and the last part will be as metallurgically and dimensionally accurate as the first.

Why not talk to National's engineers about the economic advantages of using Shelby Seamless Tubing? You can be sure that any recommendations they make will be based on a thorough study of your particular requirements.

All Shelby Seamless Tubing is pierced from solid billets of uniform steel. This is the one manufacturing method that assures absolute uniform wall strength.

WALLS WITHOUT WELDS

THIS FREE BOOK tells how you can cut production cost and make better parts. Write for it today.

NATIONAL TUBE DIVISION
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S SHELBY SEAMLESS MECHANICAL TUBING

USS

UNITED STATES STEEL

HEIL SERVICE VETERANS

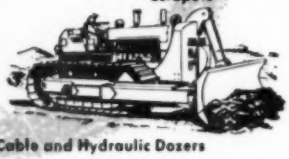
Heil Cargo Bodies

Heil Tailgate Lift

Heil Garbage Bodies

Heiliner 13 and 18-cu. yd. Scrapers

Heil Dump Bodies and Hoists


Heil Cable and Hydraulic Dozers

HEIL Quality PRODUCTS

Manufactured By

THE HEIL CO.

GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

DEPT. R-93

EM 2

SEND FOR COMPLETE CATALOG

Precision & Uniformity *in the Ball with . . .* The Armored Heart!*

Abbott Carbon Steel Bearing Balls meet Industry's most rigid requirements. Each is a model of precision, unsurpassed for sphericity, size tolerance, depth of case and other essentials of fine carbon steel bearing balls. Equally important, Abbott Balls are known to thousands of users for their uniformity and constant adherence to specifications. Specify Abbott . . . you can't ask for a better carbon steel ball!

*ONLY Abbott makes The BALL with The Armored Heart—the carbon steel bearing ball which is DEEP HARDENED and TEMPERED for maximum life, shock resistance and load-carrying ability.

WRITE FOR THE ABBOTT CATALOG-MANUAL

The ABBOTT Ball Company

70 RAILROAD PLACE

HARTFORD 10, CONN., U. S. A.

ABBOTT

WE BELIEVE THAT A STRONG AMERICA IS A PEACEFUL AMERICA

MASON & HANGER COMPANY
SILAS MASON COMPANY

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and
CONTRACTORS

Builders and Operators of
Ordnance Facilities

OFFICES:

500 Fifth Avenue
New York

Shreveport
Louisiana

Lexington
Kentucky

ammunition loading

EXPERIENCED PRODUCERS...
all types of fuzes, incendiaries, smokes and cartridges.

EXTENSIVE FACILITIES...
to meet the most exacting schedules and specifications.

american powder

DIVISION OF
BAYSHORE INDUSTRIES, INC.
ELKTON, MARYLAND, U. S. A

These Products are Backed by 22 YEARS of Metal Conditioning Experience

NEILSON CHEMICAL CO.
MANUFACTURERS OF METALPREP

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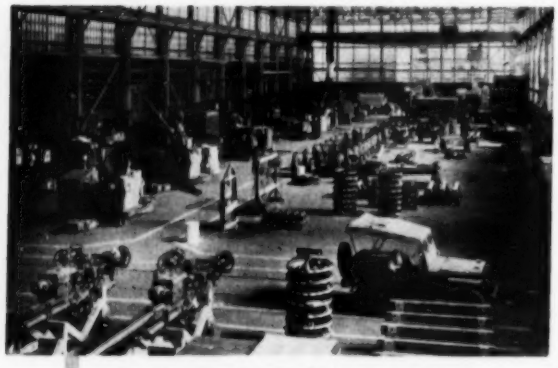
Windsor, Ontario

6580 Benson St., Detroit 7, Mich.

3411 Union Pacific Ave.
Los Angeles 23, Calif.

Specialists in ORDNANCE WORK

U. S. Ordnance and **Aetna-Standard** have worked hand in hand for the last decade on several important contracts. Recently, we completed a large production run on a jeep mount for a 105 MM recoilless rifle. We are busy on two other long-range contracts . . . one for an anti-aircraft gun and the other for an anti-tank gun. In addition to the production, Aetna-Standard assisted in the design and pilot models on both of these items. Below you see the big Ordnance assembly floor in Aetna's Ellwood City, Pa., plant.



The big assembly floor in the Ellwood City plant is the center of activity for Ordnance work.

The Aetna-Standard Engineering Company
FRICK BUILDING
PITTSBURGH, PENNA.

Take a good look at this New Powerhouse*!

LOWEST COST per kilowatt!
HIGHEST OUTPUT per pound!
MOST COMPACT!

For standby, portable, mobile, stationary use

Whatever your need for electric power, the new Onan CW—5 and 10 give you top performance and value! Here, for the first time, are 5 and 10KW electric plants powered by revolutionary, new air-cooled gasoline engines, *designed and built by Onan exclusively for electric plant use.*

Both engines are 1800 R.P.M. Weigh much less than general-purpose engines. Amazingly compact. Two-cylinder, alternate-firing for smooth power. Built to deliver dependable service in heavy-duty use. New, quiet, highly-efficient vacuum air cooling drives out all heated air through *one* side vent, simplifying installation. Impulse-coupled, high-tension magneto ignition for quick starting under all conditions. Standard voltages 60-cycle A.C.

Write for folder and specifications

D. W. ONAN & SONS INC.
2878 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

For men who know firearms

2 new shotguns from Remington

These graceful new Remington shotguns are best appreciated by the man who really knows firearms. Both the pump action Model 870 "Wingmaster" and the autoloading "Sportsman-48" are streamlined beauties in polished walnut and fine steel.

But underneath all that, there's beauty in the simplicity of their functional design. For these new Remington shotguns have fewer working parts than ever before in Remington history . . . smooth, trouble-free action . . . lightness and natural feel that make them a delight to shoot—now and through the years.

Whether you prefer the autoloader or the pump action, you've a treat in store. See them at your Remington dealer's.

"If It's Remington—It's Right!"

Remington DUPONT

"Wingmaster" and "Sportsman" are Reg. U. S. Pat. Off. by Remington Arms Company, Inc., Bridgeport 2, Conn.

GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION	PARKER PRODUCTS
JAN-C-490 (Replaces AXS-1245)	
Grade I	Bonderite 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578 (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 710 (chemical film for aluminum and its alloys)
MIL-C-16232 (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 160, 170, 180
U.S.A. 57-0-2	
Type II	
Class A & A1	Parco Lubrite 1 & 2
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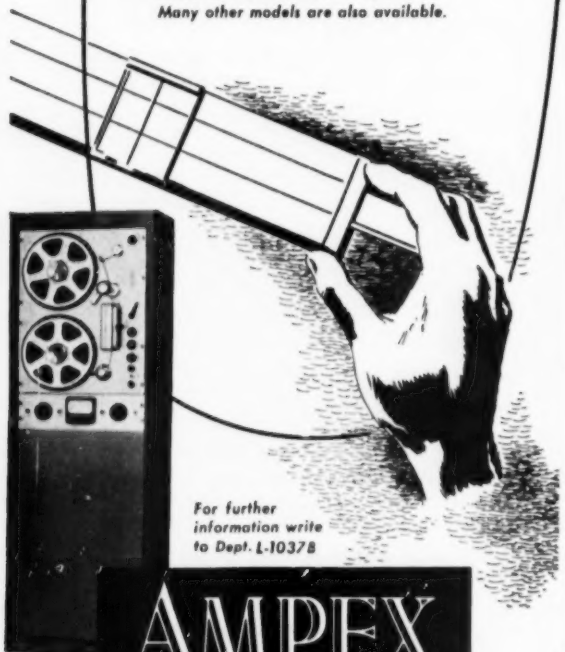

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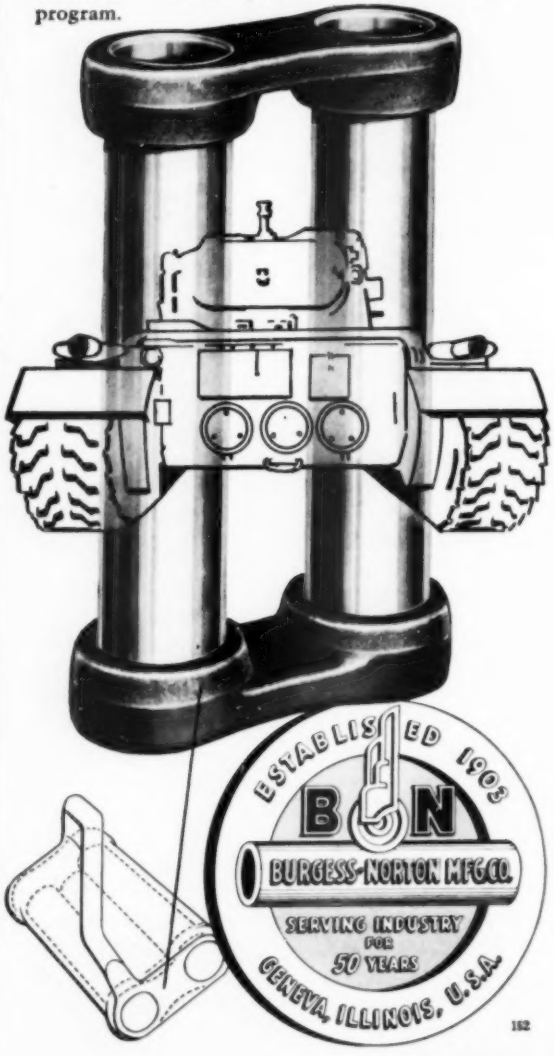

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INDEX TO ORDNANCE

VOLUME XXXVII

● The Index to Volume XXXVII of ORDNANCE, with title page for binding, is now available. It will be sent free of charge upon request to the Editorial Offices at the address below.

● It covers subjects in the following 1952 and 1953 issues: July-August (No. 193); September-October (No. 194); November-December (No. 195); January-February (No. 196); March-April (No. 197); and May-June (No. 198). It is arranged alphabetically by subject and author.

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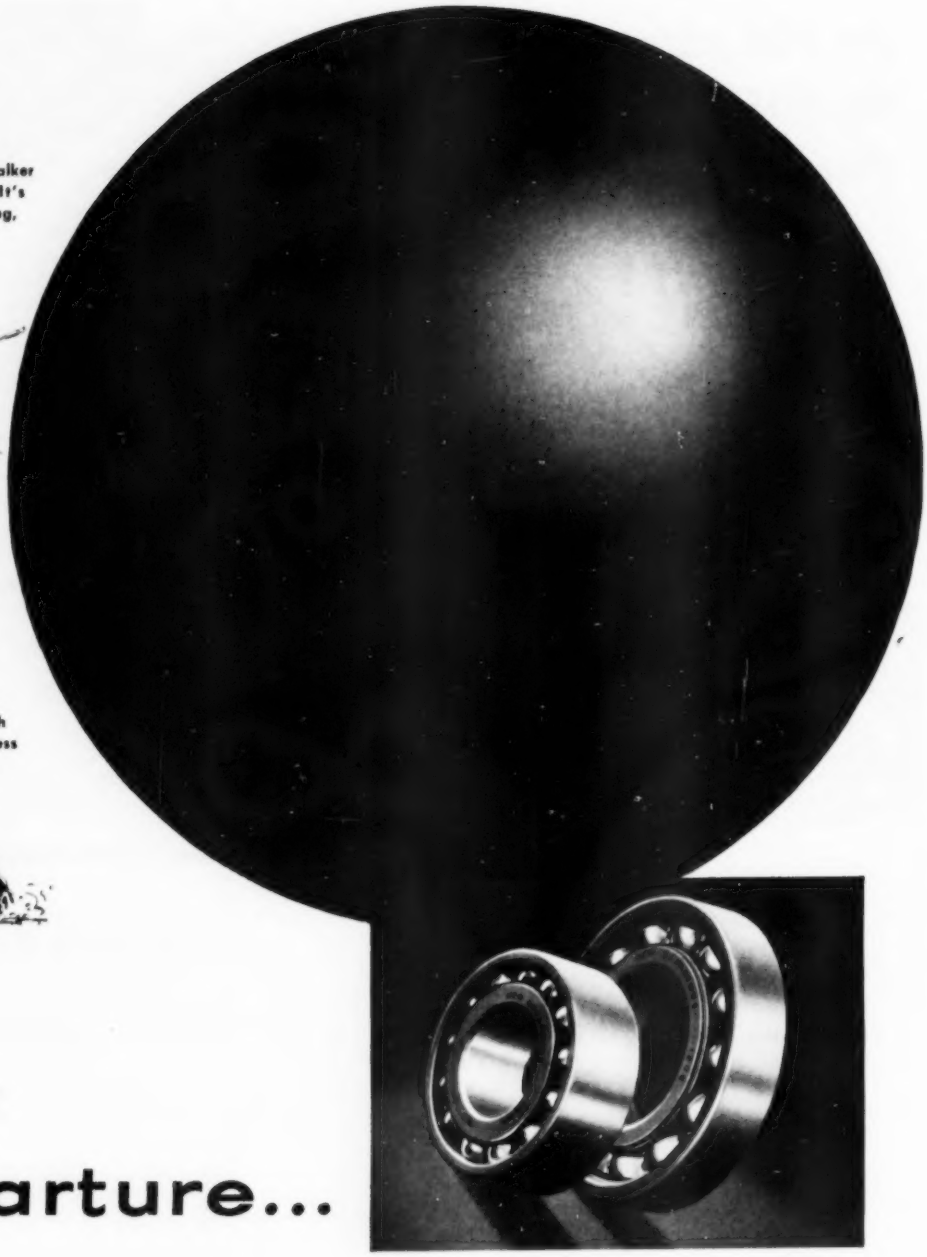

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Titanium at Work

The New Metal Continues To Lighten the GI's Burden

Carl E. Hartbower

Chief, Welding Section, Watertown Arsenal Laboratory, Watertown, Mass.

THE mortar is a smoothbore, muzzle-loading, high-angle-of-fire weapon. It consists of a mortar tube and a base plate which supports the mortar. The weapon is used for lobbing high-explosive shells over obstructions or otherwise supplementing relatively immobile artillery.

Lightness Is the Key

Since the mortar is hand-carried, it can be set up in vantage points which would be virtually inaccessible to heavier weapons of equivalent firepower. Lightness is the key to the mortar's effectiveness. Yesterday's mortar base plates were made of steel, weighed forty-eight pounds, and were carried by two men. Today's mortar base plate weighs only twenty-four pounds and, consequently, is carried by one man.

The importance of this can be inferred from the words of Gen. Omar N. Bradley in a recent magazine article: "We have not gone nearly far enough in making the infantryman's load lighter. To save himself in order to win the battle, the GI must be the best-equipped, the best-protected soldier, and the soldier with the lightest load." The metal, titanium, promises to do much to make this possible.

For a number of years scientists and engineers have searched for a structural material which would be both light in weight and have strength comparable to that of steel. Titanium is expected to meet this need. Moreover, the ores from which titanium is extracted are abundant in the United States. Titanium is, in fact, the fourth most plentiful structural element in the earth's crust.

Although titanium is sixty per cent heavier than aluminum, it is only fifty-six per cent as heavy as alloy steel. As for strength, commercially pure titanium is comparable to structural steel or even low-alloy high-tensile steel. Experimental titanium alloys, on the other hand, have been developed with tensile strengths as high as 200,000 pounds to the square inch with some ductility.

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Amyle P. Richards

On a strength/weight basis, such an alloy is more than fifty per cent stronger than the strongest formable material of construction now available. Table I shows the strength/weight advantage of commercially pure titanium over steel and its one notable disadvantage —a lower modulus of elasticity. With regard to the latter, it should be noted that magnesium has a modulus of elasticity of only 6.5 x 10^6 p.s.i.

Resists Corrosion

Besides its strength/weight advantage the most noteworthy characteristic of titanium as a material for construction is its unusual corrosion resistance, particularly to salt water.

Extensive tests have shown commercially pure titanium to be completely resistant to attack from sea water under all conditions of exposure. The tests indicate the metal to have the same high level of resistance to corrosion from sea water as platinum.

Thus titanium has an added advantage over many conventional materials of construction.

On the debit side of the ledger, contrary to popular supposition, unalloyed titanium is not a satisfactory material for use at elevated temperatures. This is due to its high reactivity with the oxy-

gen, nitrogen, carbon dioxide, carbon monoxide, hydrogen, and water vapor at temperatures above 1,200 degrees Fahrenheit and to a marked loss of strength above 500 degrees Fahrenheit (at 800 degrees Fahrenheit commercially pure titanium continues to hold a slight advantage over stainless steel, whereas aluminum is completely out of the picture).

	Titanium	*302 Stainless Steel*
Strength/Weight at 800°F.	150×10^3	120×10^3

The reaction of titanium with gases is a serious problem in the melting and joining of titanium, particularly since the reaction is irreversible and the metal is rendered useless through embrittlement. In melting and joining, processing must be carried out either under high vacuum or in inert-gas atmospheres of argon or helium.

	Titanium	*Aluminum*	*Stainless Steel*
Density (Lbs./in.³)	0.16	0.10	0.28
Modulus of Elasticity	16×10^6	10×10^6	28×10^6
Strength/Weight Ratio*	430×10^3	400×10^3	130×10^3

**Strength/weight based on typical 0.2 per cent offset yield strengths for 24ST aluminum and annealed commercially pure titanium and type 302 stainless steel.*

Table I. Comparative properties of commercial titanium and other structural metals.

One of the most spectacular developments of recent years has been the introduction of inert-gas-shielded arc welding. It has already replaced all other methods for a large percentage of aluminum and other nonferrous welding and is making large inroads into the steel—particularly the stainless-steel—fields.

No Contamination

The outstanding advantage of this method of welding is that there is virtually no contamination of the weld with undesirable gases. Moreover there is almost complete freedom from spatter, and the weld surface is so regular and clean that only a minimum of machining is required to produce a finished surface.

In joining titanium, absorption of gases occurs so readily that inert-gas shielding is essential to obtain ductile welds. The reactivity of the metal at elevated temperature is so great that an inert helium atmosphere containing as little as one per cent oxygen by volume, one per cent nitrogen, or five per cent relative humidity embrittle the weld deposit.

The air that normally surrounds a weldment consists almost entirely of oxygen and nitrogen (100 volumes of air contain approximately 21 volumes of oxygen and 79 volumes of nitrogen). In addition, air contains many other substances in small amounts, among which are hydrogen and water vapor.

The quantity of water vapor present in air (reported by the weather bureau as relative humidity) varies greatly with time and place. Water vapor breaks down in the electric arc to atoms of hydrogen and oxygen which may be absorbed by the molten weld metal to produce a strong but embrittled deposit.

The fact that the tensile strength is actually increased by gases in solution in titanium can be misleading. For example, a tensile specimen containing a weld joint transverse to the direction of loading will usually neck down and fracture outside of the weld zone, indicating better than one hundred per cent joint efficiency.

However, a weld-longitudinal tensile test will reveal an appreciable drop in elongation, and a bend test will demonstrate severe embrittlement as the result of imperfect inert-gas shielding.

The titanium mortar base plate is made of 0.10-inch commercially pure titanium sheet. The tensile properties of more or less typical sheet materials before and after joining are shown in Table II. It should be noted that in the case of the weld joint transverse to the direction of tensile strain, fracture occurred approximately midway between the weld and the shoulder of the tensile specimen; consequently the tensile properties are those of the base metal and not the weld.

In the case of the weld joint tested longitudinal to the tensile strain, all components of the joint strained equally; therefore, the weld-longitudinal tensile properties reflect the strength and ductility of the weld. A 66,000 p.s.i. proportional limit and a 103,000 p.s.i. ultimate tensile strength with 15 per cent elongation compares favorably with low-alloy high-tensile structural steel.

Welded in Chamber

The first titanium mortar base plates were fabricated at the College Park Station of the United States Bureau of Mines. To minimize contamination from the atmosphere, the welding was done inside a chamber. The chamber was cylindrical in shape, approximately three feet in diameter and three feet high with a collapsible rubber side wall and transparent cover.

The sheared materials ready for assembly together with the electrode holder were placed inside the chamber; the chamber was then evacuated by means of a vacuum pump. Upon removal of the air within the chamber, the rubber side walls collapsed. Helium was then introduced inflating the chamber to normal size.

This procedure was repeated several times to assure removal of the last traces of air. A number of rubber gloves cemented in the side walls of the chamber permitted welder's hands to reach any point within the chamber. Thus, the complete welding operation was carried out in an inert-gas-filled chamber.

Proved by Test

Mortar base plates so constructed have been tested by firing hundreds of rounds with the base plate supported on both soil and macadam without failure.

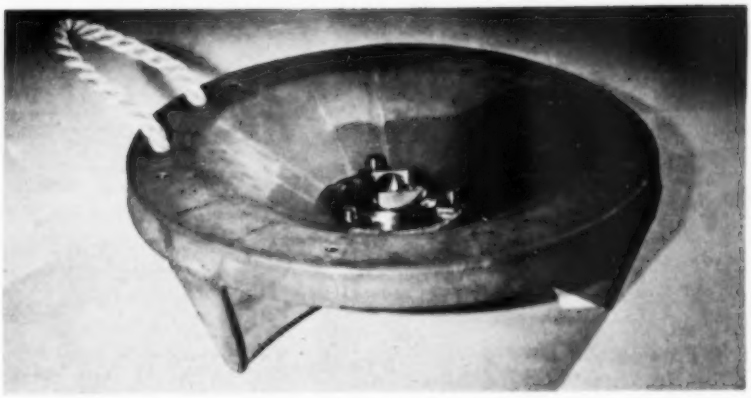
Obviously, if a titanium 81-mm. mortar base plate is to be standardized and manufactured in quantity for combat use, it would be highly desirable from a production standpoint to fabricate without the chamber.

For purposes of comparison with base plates made under ideal conditions, a set of three were fabricated at the Watertown Arsenal Laboratory without benefit of special precautions against contamination.

The simplest possible method that had any chance of being successful was used. The only gas shield was that is-

suing from the nozzle of the electrode holder. A telltale gray-to-yellow powder formed on the surface of the weld deposits and heat-affected zones—positive evidence of contamination. Oxidation was particularly heavy at the weld craters where the operator broke his arc manually and thereby removed protection while the metal was still molten.

When fabrication of the three mortar base plates was completed, they were visually inspected and radiographed. No cracks were detected. However, after several weeks had elapsed, visual inspection revealed numerous cracks in the welds, particularly, in the craters. The cracking had occurred in storage without external load.



Made of titanium, the 81-mm. mortar base plate shown above weighs only 24 pounds—exactly half the weight of the steel base plate now in general use.

Compromise Attempted

A compromise between conventional inert-gas shielding and arc welding in a chamber was attempted by the Bureau of Mines. A titanium mortar base plate was fabricated in open air, but with every precaution taken to shield hot metal with inert gas, and with techniques aimed at cooling the metal as rapidly as possible to minimize the time at elevated temperature when the metal is most vulnerable to contamination.

The base plate so constructed was subjected to severe proof testing without failure. The special techniques employed for welding outside the chamber follow:

The gas coverage, both on the top and underside of the weld, was as complete as possible. Auxiliary shielding was provided with the flow of gas maintained at as high a rate as consistent with quiet arc action. Wherever practical, a close-fitting copper backup was used in conjunction with inert-gas shielding. Partially inclosed openings were plugged and flushed with helium.

Since contamination is a function of time and temperature of the exposure to air, every precaution was taken to minimize peak temperatures occurring adjacent to the welds and the time at temperatures above 1,200 degrees Fahrenheit. Welds were deposited in increments to lessen the build-up of heat in the sheet and a copper backup served to chill the weld, making it solidify and cool more rapidly.

Burden Reduced

The titanium mortar base plate may soon go into production as standard equipment for our troops in Korea. To the soldier, the new base plate will look and act like stainless steel but be only half as heavy. As a burden carried over hill and through mud and snow, the soldier will count the weight saving as all important.

The scientist and engineer at home will follow the field test of titanium with concern over its lower modulus and possible loss of toughness in winter operation. Research on titanium is moving rapidly; new facts are revealed almost daily.

Research indicates that a long-time vacuum anneal at 1,100 degrees Fahrenheit can produce a marked improvement in the toughness of unalloyed titanium. However, practical considerations of vacuum versus controlled-atmosphere annealing are yet to be evaluated.

The toughness of commercially pure titanium as evaluated by the V-notch Charpy impact test is usually between twenty and thirty foot-pounds at room temperature. When steel has a Charpy value in excess of fifteen foot-pounds at the lowest temperature of service, it is generally accepted as adequate for structural purposes.

However, the other available light structural materials, aluminum and magnesium, have a substantially lower modulus and notch toughness than presently available titanium.

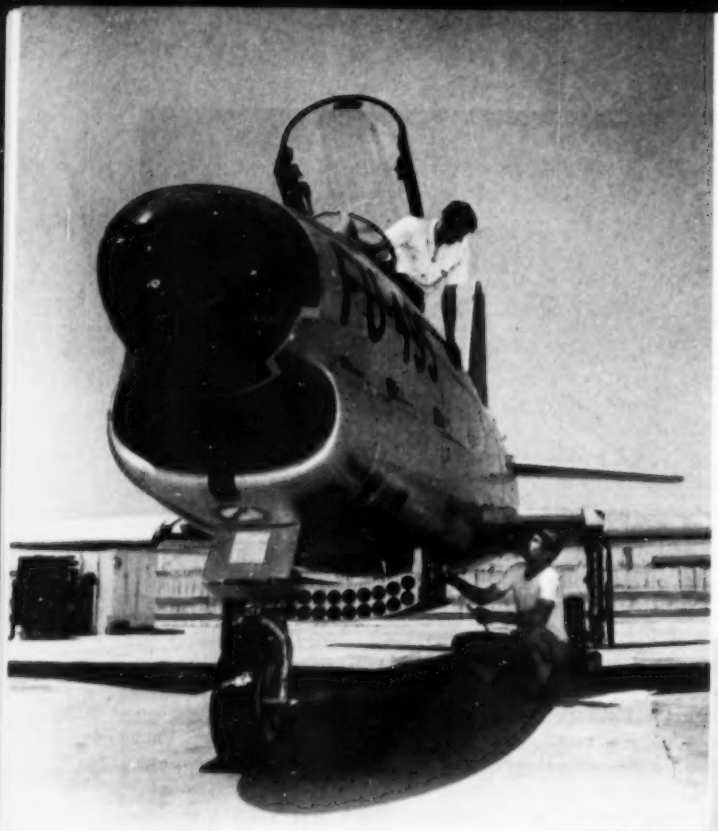
Writing on "Taming Titanium" in the July-August 1953 issue of ORDNANCE, Lee S. Busch and Robert H. Dickinson said: "Material costs will decline as titanium finds more uses. Fabrication costs are high because little is known about what occurs during all fabricating procedures. Machining costs will be reduced when titanium is machined with a full knowledge of its machining characteristics and on a full scale rather than as a substitute. . . .

"It is apparent, however, that at present the advantages in weight saving must overbalance the increased cost wherever titanium is used."—THE EDITORS.

Table II. Tensile test results of commercially pure titanium.

Manufacturer's Designation	*Proportional Limit (0.01% offset)*	*Yield Strength (0.2% offset)*	*Ultimate Strength (p.s.i.)*	*Elongation (% in 2")*
Prime Plate				
RS-55	83,500	98,200	104,200	23
RC-55	59,200	70,000	86,000	24
Ti75A	55,500	65,800	87,200	24
Butt-welded, Transverse				
Ti75A	51,700	65,300	90,300	16*
Butt-welded, Longitudinal				
	66,500	80,700	103,700	15

**Fracture occurred outside the weld zone.*



Left, the F-86D Sabre jet carries 24 "Mighty Mouse" rockets in a launching unit which tucks into the fuselage when not in use. Below, an F-86D fires a rocket barrage in a recent demonstration flight. Right, top, technician places two retro-rockets in a Navy TBF. Right, below, Navy ordnancemen hang a rocket on a zero-length pylon fitted under the wing of a Douglas AD Skyraider.

Air Force

Aircraft Rocket Launchers

Continuing Developments in Mounting Aërial Armament

Lieut. Comdr. Arthur L. Schoeni

PREDICTIONS by armament experts that the supersonic fighter plane of tomorrow will be armed with small rockets instead of machine guns or cannon focuses the spotlight on that newest of aircraft weapons.

Of all the bullets, shells, and missiles developed in modern warfare, probably none surpasses the aircraft rocket in the variety of ways fighting men have tried to fire it.

Rockets date back to Chinese antiquity and our own "Star Spangled Banner" tells of the "rockets' red glare." But it was not until World War II that men began hanging rockets on their fighting planes. Since then, about fifteen different systems of hanging rockets on the wings, under or in the fuselage have been tried. They have included tracks, tubes, troughs, pylons, "Christmas trees," lanyards, and tanks —all aimed at carrying the rockets and firing them with least damage to the plane.

Tomorrow's plane, and even some of today's, will attack enemy bombers with 2.75-inch spinner or fin-stabilized rockets fired from disappearing racks or droppable tanks. The day of the caliber .50 and 20-mm. guns of fighter planes appears to be waning.

The 2.75-inch rocket may sound small compared with the 5-inch and 11.75-inch aircraft rockets being used in the Korean war today, but it can knock any plane out of the air. Remember, it is only a shade smaller than a 75-mm. artillery cannon shell, which is considered pretty potent.

The Navy today is working on lightweight cardboard tanks to hold nineteen of the 2.75-inch rockets. Its workhorse attack plane, the Douglas AD Skyraider, has fourteen rocket and bomb pylons, each capable of carrying one of these "pods." Consider, then, the firepower those 266 aircraft rockets would give a single plane should the Navy decide to arm them in that manner.

Navy photo

Skyraiders in Korea have taken off the ground with 9,000 pounds of bombs and rockets and flown off carriers with 7,200 pounds. Those 14 podsful of Mighty Mouse rockets, as the Navy's 2.75-inch missile is nicknamed, would weigh far less than either figure.

Numerous Ideas

The rockets are already developed, and armament men are busy working out the best way to carry and to fire them. The ideas they have come up with since the Russians first loaded rockets on planes in 1941 have been both ingenious and numerous.

With their emphasis on close support of ground troops, a Russian fetish in World War II, the Reds hung rockets on the IL-2 Stormovik attack airplane and later on the MIG-3's and Yak-1's.

Germany in 1943 sent rocket-firing Focke-Wulf 190's and Messerschmitt 109's and 110's against our daylight bombers with devastating effect. Early attempts at firing rockets from planes utilized launching rails under the wings or launching tubes not unlike king-sized mailing tubes.

Those systems had several disadvantages. They were heavy and cumbersome—and were ninety inches long. They slowed down the attack planes from six to ten miles an hour—a prohibitive penalty to put on a fighter, although not too serious for bigger torpedo bombers and other rocket-carrying planes.

The heavy rails and tubes reduced the maneuverability and range of the planes and few rockets could be carried. It was estimated that a torpedo bomber was slowed down as much as seventeen miles an hour by its rocket rails.

The biggest problem with firing rockets from plane wings was the terrific tail of flame from its blast. If the rocket were hung too close to the wing surface, or if the aileron were lowered in a turn, this blast would burn off the trailing edge of the wing and frequently cause planes to crash.

The Air Force first tried using 4.5-inch rockets in clusters of 3-tube launchers. The tube restricted the rocket blast but it presented a problem because of the rocket's fins. Folding fins were developed, which popped out when the rocket emerged from the tube. This same idea has been revived on today's Mighty Mouse and Aërobee 2.75-inch aircraft rockets.

Rockets vs. Subs

The British enjoyed such success with their 3.5- and 6-inch aircraft rockets in sinking submarines—they bagged nine in 1942 and 1943—the U.S. quickly got into the game. With the submarine menace the biggest problem of that time, the Navy tried using rockets against U-boats. Its TBM torpedo bombers and PBY patrol bombers carried launching troughs alongside their fuselage (see photo above). From these, backward-firing rockets were dropped on the subs which the planes' magnetic detectors had "smelled out" below the waters.

These retro-rockets had only small charges of powder pushing them. The idea was for the pilot to fly at the same speed as these rockets would shoot out backward. Thus the rocket would drop straight down and hit the sub as the plane flew over it.

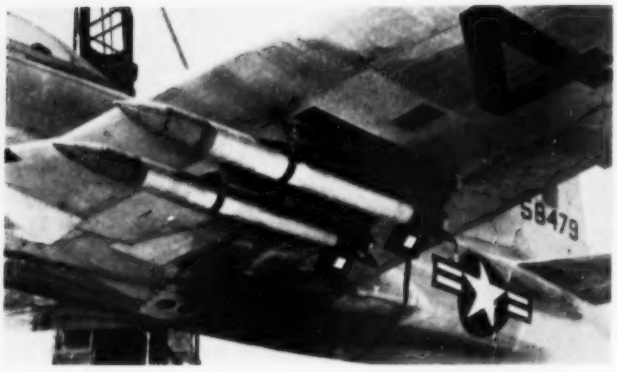
Soon Outmoded

Called the "Mousetrap," this retro-rocket soon was outmoded, but not before Navy squadron VPB-63 located and help sink a U-boat and score two "probables" using retro-bombs near Gibraltar in 1944. The last Mousetrap kill was in April 1945, when a Catalina from the same squadron spotted a snorkel sub in the English Channel and sank it—the last use of retro-bombing and the final sub sunk in the war.

About the time the Navy got its Mousetrap rockets installed, the U-boats changed their tactics. They stayed on the surface and shot it out with attacking planes. The Navy immediately took off the retro-rockets and installed forward-firing rockets so it

Commander Schoeni has been on the staff of the *Naval Aviation News* since 1943 and has served as editor of that publication since 1946.

Left, twelve 2.75-inch rockets are packed in the wing pod of the F-94C Starfire. The fiber-glass pod cover automatically disintegrates before rockets are ejected. Below, the Starfire with rocket doors open revealing the firing tubes surrounding the nose.



Above, retractable mount holds 5-inch rockets; folds into wing after firing. Below, "Christmas-tree" type launcher mounted on wing.

Air Force photos

Lockheed

Aviation ordnancemen, below, place nine of a possible thirty-two 5-inch rockets on wing of F-84 Thunderjet.

could retaliate with greater range and accuracy.

The Navy did not like the eight 90-inch rocket rails under its planes' wings, so it developed the zero-length launcher in 1944. These two small, streamlined posts held the nose and tail of the rocket until firing and presented far less wind resistance and weight than the rails.

These two pylons later were replaced by a single, larger zero-length one which could hold rockets, gas tanks, napalm tanks, or bombs—a multipurpose installation.

Retractable Launchers

The Air Force wanted still greater streamlining and came up with retractable zero-length launchers. Three of these spring-loaded pylons were used to hold each rocket, one at the nose and two attaching to the rocket's fins. Upon firing, these pylons retracted into the wing automatically. This type launcher is used on today's fighter-bomber jet (see p. 350).

As World War II progressed, the 3.5-inch aircraft rocket was felt to be too small, so the Navy developed the "Holy Moses"—a 5-inch rocket with plenty of punch and velocity.

But the Jap ships and fortifications withstood this powerful rocket so the Navy brought out the final word—the 11.75-inch "Tiny Tim." This 1,284-pound monster spewed a sheet of flame 50 feet behind it when it was fired and created an entirely new problem of launching.

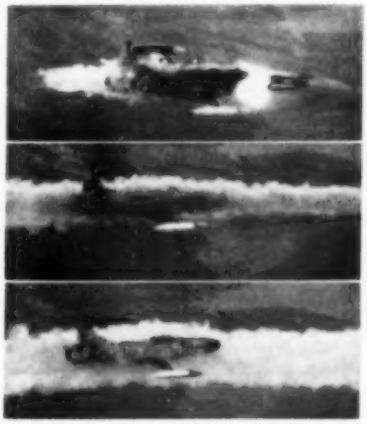
At its desert ordnance testing station at Inyokern, Calif., the Navy tried dropping these Tiny Tims away from the fuselage of the launching plane with a forklike displacing arm, much like those used to toss bombs clear of the propellers on the old SBD's.

Pilot Killed

In testing this system in an SB2C, Lieut. John M. Armitage, a test pilot, was killed when the Tiny Tim blast damaged the tail surfaces of his plane. The rocket had to be still farther from the plane before it was fired, so a lanyard system was developed. The rocket was allowed to drop away from the plane sixteen feet, with an electrical cord still connecting the two. Then it was fired and the tremendous blast did no harm to the plane.

Tiny Tims used in Korea were carried on zero-length pylons and fired by lanyard. They did not see much action there because of the scarcity of heavy fortifications or big warships for which the rocket was designed.

We have covered three types of launchers for firing aircraft rockets—rails, zero-length pylons, and lanyard drops. But a lot of experiments were made between the day the Navy fired its first rocket in combat in 1944 and today.



In burst of fire, a Starfire launches its rockets. Exhaust smoke caused jet engines to have flameouts during early trials.

Fighting men wanted to load more and more rockets on their planes. The Air Force even attached thirty-two Holy Moses rockets on an F-84 fighter-bomber, although it never has loaded them to that extent in combat.

In an effort to get more rockets aboard a plane, both the Navy and Air Force began looking at finless rockets which could be fired from inside the plane. Some one tried putting a 75-mm. cannon in the nose of a B-25 bomber, but the resultant recoil was too heavy for the plane's structure to absorb satisfactorily.

Taking a hint from this, the Navy buried two rocket tubes in a PBJ (B-25) nose and fired spin-stabilized rockets from them.

Having no fins to guide their flight, these shorter 5-inch rockets get their accuracy by spinning in flight like a bullet fired from a rifled gun barrel. The spin is imparted by having angled exhaust nozzles in the rear of the rocket.

The Navy also tried firing these spin rockets from tubes located in the wing of an AD Skyraider. Thirty-eight of these big rockets were loaded inside the two wings and fed into the launching tube like machine-gun bullets. The flaming exhaust was diverted downward below the plane's wing but proved damaging to the surface.

Nose Installation

This was a post-World War II development. A newer experiment with tube launchers was tried on the Air Force Starfire jet. Around the nose of this Lockheed fighter were located twenty-four tubes, each holding one 2.75-inch rocket (see p. 350). These small missiles were designed to be fired against other aircraft, being too small to damage most ground targets but capable of destroying any plane in the air today.

These little Mighty Mouse and Aërobee rockets have folding fins. In the Starfire, their exhaust is contained in the rocket tube rather than being funneled out to the rear. Early tests with the rockets showed some difficulty from the rocket's exhaust fouling up the plane's jet engine and causing flameouts but this has been solved (see photos above).

Another Starfire rocket installation being tried out places two 12-rocket wing pods on the leading edge of each wing like radar domes, augmenting the twenty-four rockets in the jet's nose (see p. 350). Emphasis today seems to be on these pods or tanks.

The Navy loads 7 to 19 rockets in these streamlined tanks and suspends them below the wings on pylons. The Air Force is trying out such pods on the wing tips of its F-89D Scorpions.

Latest Development

The latest rocket launcher revealed is that on the F-86D Sabre jet. This retractable launcher can be lowered under the fuselage to fire its twenty-four 2.75-inch Mighty Mouse rockets and then retracted to improve streamlining (see p. 348).

The progressive development made in arming our aircraft with better launchers for more powerful rockets indicates that this type of armament may well become the principal weapon of our fighting planes, perhaps finally supplanting machine guns and cannon.

The "Off-Axis" Telescope

A New Ordnance Development for Tracking Test Missiles

E. E. Simmons

Public Information Office, White Sands Proving Ground, Las Cruces, N. Mex.

A TRIO of practical civilian "star gazers" at White Sands Proving Ground have developed a new invention intended to facilitate photographic data vitally important to the research and development of Army Ordnance guided missiles and rockets. They are Clyde W. Tombaugh, known to astronomers throughout the world as the discoverer of the planet, Pluto; William C. Braun, physicist, formerly associated with the Yerkes and McDonald Observatories; and 26-year-old Clyde R. Dennon, mechanical engineering graduate of Notre Dame University.

All three are employed at the Flight Determination Laboratory, White Sands Proving Ground, N. Mex.

Need Observed

Mr. Tombaugh, optical staff physicist, observed a need for a type of missile-tracking telescope not available through customary channels supplying optical equipment. Undaunted by the fact that the desired apparatus had not yet, to common knowledge, been developed, he devised plans for the type of telescope needed, an adaptation of a German optical system which he altered to meet the specific tracking requirements of White Sands Proving Ground.

In 1930, Bernhard Schmidt, of the Bergedorf Observatory, near Hamburg, Germany, invented the most remarkable optical system of the past half century. The Schmidt system consisted of a spherical, concave primary mirror and a thin nonspherical correcting plate at the center of curvature of the mirror.

Rays Deviated

To prevent spherical aberration (a defect resulting from spherical surfaces), the rays of light were deviated slightly from their parallel course so that when the rays struck the concave mirror, they converged to a point at the focus. Moreover, parallel beams inclined to the principal optical axis were also brought to sharp points in the focal plane for all portions of the field, unlike the short-ratio parabolic-mirror system.

System Acclaimed

The Schmidt optical system was acclaimed throughout the world. However, modern as the system was, it was not fully adequate for the needs of the Ordnance research and development program at White Sands Proving Ground.

It was due to these deficiencies that Mr. Tombaugh devised the "off-axis" Schmidt telescope now under construction in a small basement workshop at the White Sands Flight Determination Laboratory.

Studies by Mr. Tombaugh and his associates revealed the standard optic cones, which come with high-speed cameras, are not always adequate to meet certain photographic requirements of some small, high-velocity missiles, especially those with high elevation angles where the burnout point is very high above the ground.

Velocity Important

Burnout velocity, according to the proving-ground scientists, is especially important in ballistic rockets because that point corresponds to the muzzle velocity of an artillery gun. At least two trajectory points at burnout, each from not less than two optical instruments, are required to furnish data for the determination of velocity in space.

The exceedingly high-velocity of some small missiles makes it necessary to limit the exposure time to about 1/10,000th of a second, or less, in order to "freeze" the missile in flight and obtain readable images. This requires a very "fast" optical system of about *f*3 (the focal length is three times longer than the diameter of the aperture which makes for a clear and brilliant image.

The smallness of the missile and its height above the ground require a scale of images that can be obtained only with focal lengths of about three feet or more. This means the aperture of such an instrument must be twelve inches in diameter.

Lens systems of the refractor type for this size and focal ratio would be impractical and expensive. Certain image defects (known as "coma" and "astigmatism"), over the field become intolerable with parabolic mirrors of very short focal ratio.

Used in Astronomy

The Schmidt system proved itself of extraordinary value in astronomical use where a cut film is placed in a special film holder in the middle of the tube at the focus, halfway between the correcting plate and the spherical mirror, to record the images of stars and nebulae at night with exposures of several minutes. In missile firings, however, a very rapid frame rate is required in the taking of photographs.

This necessary rapidity introduced a difficult problem at the Army Ordnance facility. A motion-picture camera mechanism is large and obstructs too much light in the beam. Also, the film in motion-picture frames must be flat, whereas the focal plane of images in the Schmidt system is strongly curved (convex toward the mirror).

Fortunately, it is known that the curved-image plane can be reduced to a flat one by the use of a simple plano-convex lens placed just in front of the film.

Cone Too Steep

At first it was thought to use a flat mirror inclined forty-five degrees to the optical axis (called the "diagonal mirror") to intercept the image plane to the side of the tube into the camera (the Newtonian form). But the "steep" light cone in such short ratio would require a fairly large and expensive optical flat to avoid vignetting, even for a limited field.

The light loss from this arrangement

would amount to about 40 per cent, which is equivalent to prolonging the exposure from 1/10,000- to 1/7000-second. Obviously, this is a disadvantage as regards "travel blur" of missiles.

It was then decided by Mr. Tombaugh to depart from the conventional form of Schmidt design to an "off-axis" one in which there would be no obstructions in the light beam. The principal optical axis would then be placed to one side of the entire light beam, and even outside the telescope tube. A high-frame-speed camera would then be attached to the side of the tube on the principal optical axis and facing the vertex of the concave mirror. Stray light, in the new adaptation, would be eliminated by the use of a closed tube with a fairing on one side to admit the beam of the camera.

Difficult To Make

Unfortunately, the off-axis Schmidt is much more difficult to make. In addition to being unsymmetrical (aspheric), the "correcting plate" must also be ground in decentered zones. The theory of this procedure was worked out by Mr. Tombaugh. The curve depths were computed, and the necessary grinding jig and testing equipment were designed by Mr. Braun at the laboratory.

Following Mr. Tombaugh's design, Mr. Dennon drew up the blueprints for the off-axis Schmidt and worked up the mount for the actual structure for holding the optics of the camera. The actual work of grinding, requiring continual minute measurements, was begun by Mr. Braun.

Delicate Work

The exactitude of the work was described by Mr. Tombaugh as "a science dealing with the finest quantities of material removal of any trade known. Such material removal as the grinding of the mirror for the off-axis Schmidt requires exactness within a few millionths of an inch."

Mr. Braun, like his associate Mr. Tombaugh, found the equipment at hand was not adequate for the infinitely small measurements required in grinding the mirrors. To facilitate his work, Mr. Braun devised and developed a "thickness gage" in the basement workshop which will check measurements to 1/2,500 of an inch.

From the grinding apparatus, which is set atop an ordinary metal barrel and is cushioned, to protect the mirror, by a chunk of hand-hooked rug, Mr. Braun frequently moves the mirror to a near-by desk to check the depth of the curves against the lines of the working graph.

The simplicity of his "thickness gage" is deceptive. A standard gage was attached to a solid metal frame on which the mirror rests during the measuring, balanced by two small blocks of wood which hold it steady.

First Application

As far as is known, this is the first application of the German Schmidt optics to guided-missile and rocket informational data. The motion-picture-camera requirement was a challenging consideration of the off-axis form of the Schmidt. The large size necessitated an unconventional grinding technique. It is, undoubtedly, an experiment with great potentialities for Army Ordnance instrumentation.

The two off-axis Schmidts are now more than halfway along in construction. Two are necessary since this is the minimum number needed to provide coördinate points. With a focal length of 33.85 inches, it may be possible to determine absolute positions of trajectory points by star orientation to an accuracy of one part in 200,000, which is equivalent to one inch in three miles.

Rapid Exposure

The primary mirrors are 16½ inches in diameter with curves ½-inch deep. The net aperture of the "correcting plate" is 12 inches in diameter, giving the effective focal ratio of 2.82, which should permit exposure of less than 1/10,000 second. Each instrument will be 6½ feet long and will weigh approximately 600 pounds without the mounting.

The civilian employee trio's work will not end with the anticipated successful completion of the new type telescope. Once the equipment is ready to leave the shop, it will be tested in the field under the supervision of its designer and his associates to determine its full capabilities.

To Check Carefully

Each minute phase of the equipment will be checked and rechecked for accuracy and fulfillment of the needs of the rocket and guided-missile program. Once it is determined that there are no "bugs" to be ironed out, the prototypes will be contracted for large-scale production.

Mr. Tombaugh expressed the sentiments of both himself and Mr. Braun when he stated: "Whether or not some one else has devised a similar apparatus for such work, we don't know. We believe that these are the first of their kind for this specific purpose. We will be only too glad if others, with similar missions, can profit by our devices without having to spend time developing something which we have already constructed and which, from calculations made to date, are believed to be as near accurate as possible without actual field tests.

"After all, it's just part of the days' work. If we don't have what we need, we build it, not only for our own use but for the advancement of others seeking to further the guided-missile and rocket program for the defense of the Nation and for scientific research in time of peace."

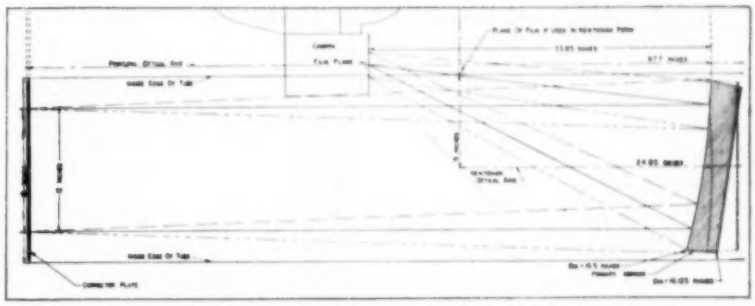


Diagram of the off-axis Schmidt telescope with 12- to 16-inch diameter aperture, 33.85-inch focal length, and an effective focal ratio of 2.82. Rays indicated by — — and — - - - — are each two degrees off the principal optical axis.

First delta-wing craft to fly was the American Convair XF-92A, above. Designed for supersonic speeds, the XF-92A used an afterburner to increase engine thrust.

Flying Triangles

Delta-wing aircraft offer excellent engineering possibilities in supersonic research and development for aërial combat.

by

Joseph Bonanno

IT now seems that the flying shape of the near future is not the saucer but the triangle. The flying triangle or "delta" (so called because of its similarity to the Greek letter) is rapidly coming into the aëronautical picture as the symbolic wing shape of supersonic flight, just as the conventional wing has symbolized a half century of flight below the speed of sound.

Now in Development

Today delta-wing aircraft are in various stages of development by the major air powers—the United States, Britain, Russia, France, Sweden, and Canada. Although the first delta flew in the United States, Britain put the first delta, the Gloster Javelin, into production and into operational use and turned up the first delta-wing bomber, the Avro Vulcan. The first production order for a U. S. delta recently went to Convair for its F-102.

Like most "new" aëronautical ideas, the delta-wing theory was propounded some time ago. Credit for its development is generally given to Dr. Alexander M. Lippisch, once an engineer with the German Messerschmitt firm. His studies led him to report, in 1943, that the triangular wing shape, or planform, appeared most suited to the requirements of high-speed flight.

Brought to U. S.

Lippisch had a number of delta-wing projects on hand when the war ended, including a glider for low-speed research. At that time, along with other German scientists, he was whisked out of his country to the United States.

In this country his pioneer knowledge of the theory was effectively utilized in the development of the Convair XF-92A, which made its first flight in 1948 to begin the world-wide scramble to get deltas into the air.

But why the delta?

To begin with, the delta is seen as a possible solution to the problems of high-speed flight, and it is necessary to review what is known about flight in the area popularly known as the "sound barrier."

The aircraft designer, aiming for a high-speed plane, attempts to achieve that speed with a minimum of power so that he may gain increased range or load-carrying ability. Since aircraft power is expended in overcoming air resistance or drag, it follows that the most economical performance can be gained where the air resistance is least —at high altitude.

At this point another factor—the sound barrier—acts to increase air resistance, and this becomes a problem sooner at higher altitudes where the speed of sound is considerably lower (660 miles an hour over 30,000 feet) than at sea level (about 760 miles an hour).

As an aircraft approaches Mach 1 (the speed of sound at a given altitude) it meets new problems of air resistance. At Mach 0.8 (80 per cent of the speed of sound) for example, the air-flow pattern begins to change.

Shock Waves Caused

Air particles do not have enough time to flow smoothly over and under the wing but cause shock waves and therefore a sharp increase in air resistance; hence a need for more power. To make matters worse, a tendency toward lack of control develops.

Mr. Bonanno is an aëronautical journalist whose articles have appeared in the *Journal of the Franklin Institute* and in other industrial publications.

First operational delta-wing airplane is the British Gloster Javelin, above. Tail is placed exceptionally high to allow it to function in air undisturbed by wings.

Above, Sweden's SAAB-210, a tiny delta used primarily for research at low speeds. Below, the British Avro Vulcan, first delta-wing bomber placed in actual production.

The problem, then, is to design a wing that will overcome, or be less susceptible to, the changes in air flow near the speed of sound.

To do this, designers have outlined four requirements of the ideal planform, two of which will seem quite obvious. First, reducing wing thickness means the wing will have to push less air out of the way and, secondly, sweeping the wing back means it can cut into the air mass with less effort. These two principles may be applied to slicing with a knife: a thin blade, pressed through at an angle, does the job smoothly and with less effort.

Other Requirements

The additional two requirements are more obvious to the aërodynamacist than to the layman. It has been found desirable to design a low-aspect-ratio wing (one nearly as wide as it is long) not only to help overcome air resistance but to help counter certain shortcomings of the swept wing, such as poor low-speed flying characteristics. The fourth requirement is low wing loading; that is, plenty of wing area to carry the aircraft weight.

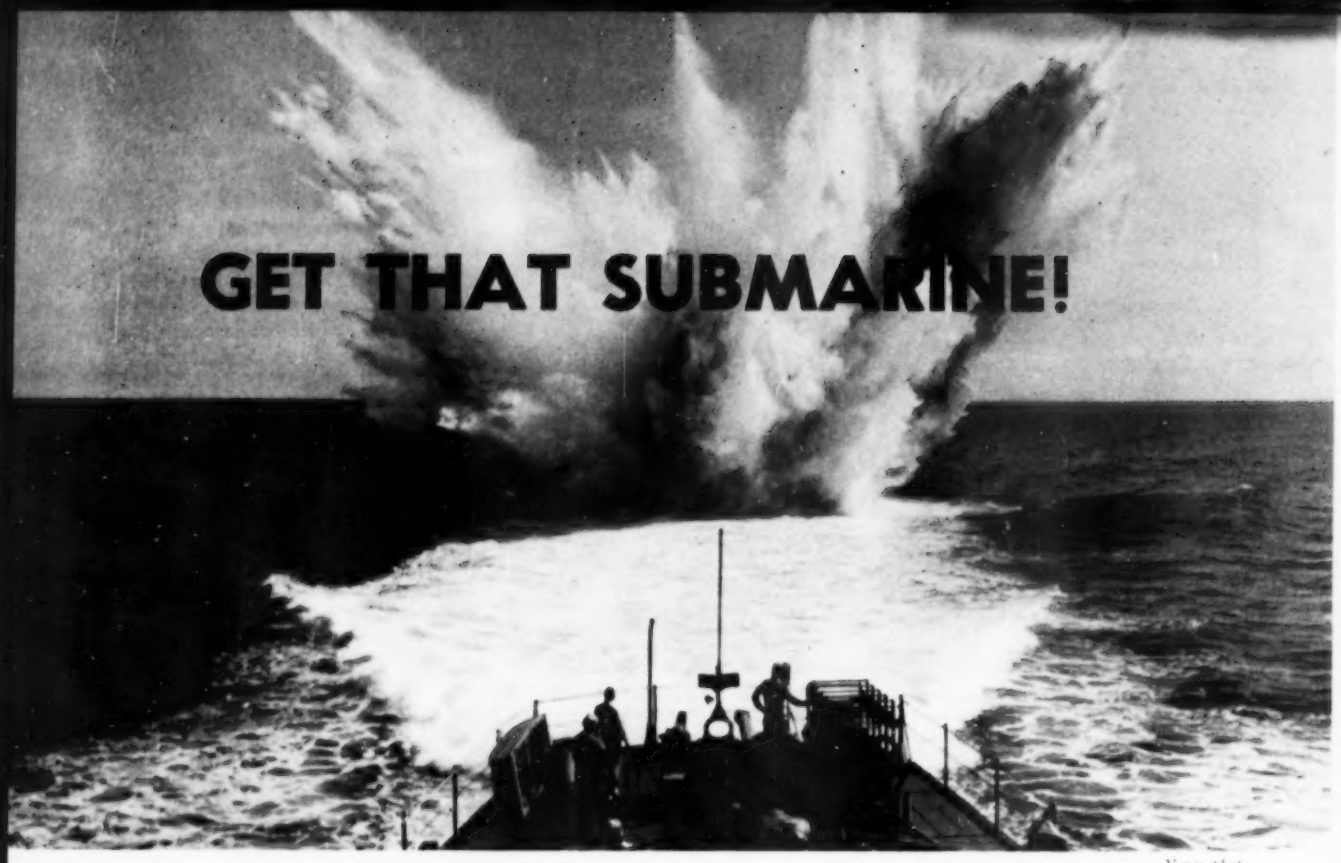
Consider these four basic needs—thinness, sweepback, near equality of width-length dimensions, and large wing area. Try sketching possible wing shapes to meet these needs, and the triangle emerges as the best possible planform.

There are additional advantages to the delta wing. The horizontal stablizer and elevators can often be eliminated since the delta wing appears able to take over their duties; all but one, that is—the delta wing seems unable to provide the necessary control for spin recovery. Since this is no problem with the bomber or transport, the tail can be eliminated, thereby cutting down on unnecessary weight, cost, and maintenance. The fighter, it appears, must keep the tail.

Stiffer Wing

The structural design of the delta wing is more desirable than the conventional wing in that it is "stiffer" and promises greater stability.

Certain disadvantages of the delta, mainly its low-speed flying characteristics, still represent a challenge to the designer, but the impressive beginning made by the flying triangle assures it the aëronautical spotlight in the near future.



Navy photo

The Underseas Rôle of Sonar in Tracking the Enemy

Amyle P. Richards

NOT too long ago, in fact only a few decades back in time, control of the seas was relatively simple. A nation had only to provide itself with the proper number and types of combatant ships and that nation had potential control of the seas. These ships could be equipped simply and their crews could be trained easily and quickly.

Different Today

It's a different story today. The airplane and the submarine became serious threats to surface naval warfare at about the same time. To the meaning of control of the seas now must be added control of the air above the seas and of the waters beneath their surface. Because of this, we have been transported from a world of two dimensions to one of three dimensions.

Underneath the surface of the seas, objects are hidden. Light waves penetrate but a short distance, limiting visibility almost to zero. Radar and infrared methods are even more ineffective at piercing this boundary of invisibility.

This then, in time of war, becomes our dimension of gravest danger. For it is the habitat of the submarine where it can prowl, lurk, and inflict terrible damage upon surface shipping. This destruction would be swift and complete except for one thing—sonar.

What is sonar? The word itself stands for sound navigation and ranging and was given by the United States Navy to equipment using the principles of underwater acoustics for sending and receiving information through water.

Mr. Richards is in the Sonar Branch, Electronics Division, Navy Bureau of Ships, Washington, D. C. He has written a number of articles for the *Buships Journal*, publication of the Bureau of Ships.

Actually, sonar equipment is more than the definition would indicate. It can be said to have a dual personality for it embraces two fields of technology —electronics as well as underwater acoustics. Thus when a complete device is developed, designed, and manufactured by one contractor, he must avail himself of a group of specialists not required for other electronic devices. Small indeed is the number of companies which can qualify in all respects.

Use Can Be Limited

Equipment bearing the name "sonar" can be simple or it can become exceedingly complex. If too simple, usefulness is extremely limited. On the other hand, if it is highly complex, its usefulness may again be extremely limited.

Such equipment may exceed the fondest hopes of its designers while it

is operating—but it may operate only a small per cent of the time, and maintenance may be a practical impossibility. Somewhere in between these two extremes is the desirable optimum.

More is always demanded of sonar than it can actually accomplish. The submarine can dive deeper, remain submerged longer, and attain greater speeds today than it could as recently as the Battle of the Atlantic. Every one recalls how really terrible those monsters were and what they cost the Allies.

Must Be Detected

To combat these denizens of the deep successfully, their whereabouts must be established before they can arrive within the effective range of their weapons—and that range also has increased.

All this means that the requirement exists for sonar on surface ships to detect, classify, determine range, depth, course, and speed of the submarine at ever-increasing distances and in shorter time than was required less than ten years ago. Challenging times are ahead!

In the meantime, let us have a closer look at sonar, and, for the moment, let us consider the active type of sonar. By active sonar is meant that the equipment originates its own sound and utilizes it to obtain information concerning a distant object as follows:

Within the electronics part of the equipment, electrical power of high intensity is generated for a very short interval of time. This is called a power pulse. It travels through the electrical circuitry to a device known as the transducer located underneath the ship at its keel.

The transducer converts the electrical power pulse into mechanical energy or vibrating motion.

Produces Wave Form

This motion imparts a minute movement in the water particles, and since this movement is vibratory in nature a wave form is produced. Such a wave is known as an acoustical wave and travels outward from its source with rapidly decreasing energy to theoretical infinity, although there is a practical limit.

After the transducer has been energized for this brief interval of time, it becomes a listening device ready to receive sounds. In the meantime, the acoustical wave continues outward from its source until it reaches some distant object. A part of the wave bounces and travels backward along the path from which it came until it returns to the transducer with energy now far below the magnitude of its original value.

However the transducer in its receiving state is sensitive to such low power and converts this returning acoustical wave into electrical energy or a signal.

Electronic amplifiers multiply this signal to a usable value, and additional electronic circuitry processes the signal in a variety of ways and finally causes it to appear on the face of a cathode-ray tube not unlike the picture tube in a modern television receiver.

This process may appear as a long-drawn-out procedure, but actually the elapsed time is short.

Circuits at Work

During the time the acoustical wave is traveling out and back, still other electronic circuitry in the equipment has been at work measuring time and establishing conditions for display of the signal on the face of the "picture tube." Other circuits have been preparing for a repeat performance.

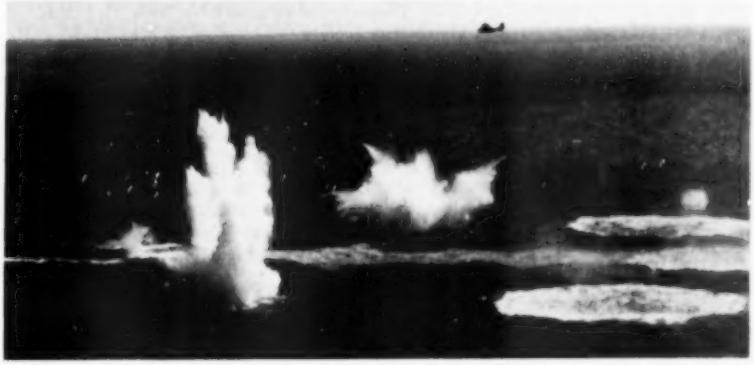
What type of information is thus presented and of what tactical value is it? Fundamentally, the very fact that a signal has been displayed indicates that an object or target is out there in the water. Secondly, directional data indicates target bearing. Thirdly, the timing circuits convert time required for the wave to travel out and back into distance or range. These last two bits of information enable the sonar operator to locate the object or target.

Identify Target

Let us assume the object is suspected of being a submarine. Detection, the first phase of the hunt, has been accomplished. The next order of business is that of attempting to determine positively whether the target is a submarine. This is known as target classification. The process by which this is accomplished is classified information and will not be discussed in this article, nor is it particularly germane.

Assume now that the target has been classified as a submarine. During that time interval the distance or range between the hunter ship and the target has decreased to a point where another phase of undersea warfare may be employed—the tracking phase.

The type of sonar equipment used



Above, a "Loon" guided missile is launched from the submarine Cusk. Below, a destroyer, teamed up with a patrol plane, drops a close pattern of depth charges on target (Navy photos).

for this work possesses greater accuracy in range and bearing than does the detection sonar and is capable of maintaining contact with the target. While this phase is in process, preparations are made for the attack.

The Attack Phase

When conditions have been met to so permit, action passes from the tracking phase to the attack. It is in this phase of the tactical situation that the most accurate and complicated sonar equipments must be employed. This sonar must be capable of determining range, bearing, course, speed, and depth of the target to the highest degree possible. This type of information must be fed into fire-control equipment so that whatever weapons we have may be used to their greatest advantage to effect destruction of the enemy.

Sonar is not a weapon; rather it is an instrument or device by means of which our Navy may seek out the enemy and bring our weapons to bear upon him to his destruction.

Different Viewpoint

The discussion on the detection, tracking, and attack of a submarine as functions of tactical situations applies whether the surface ship is one of the escort vessels of a convoy or one of a hunter-killer group. There is a difference, however, from the strategic point of view.

On patrol well out from shore the hunter-killer group is attempting to keep the ocean clear of enemy submarines and to destroy them if possible before they can approach a convoy route.

Deliberate Method

Also, from detection through attack, the operation can be in deliberate fashion. This is not meant to say that unnecessary delays are practiced but rather that in a deliberate attack certain tactics can be employed which work to the advantage of sonar. Thus the probability of destroying the enemy is higher.

Much less often can convoy escort vessels employ the deliberate attack. By the time the enemy has been detected he may be very near the range of his own weapons. To prevent his approach to a position from which he can launch his attack, rapid action by one or more of the escort vessels is necessary. Under these conditions, the urgent attack is carried out.

> **"What can the submarine have in 1963 that will change the picture? Three principal changes could be: first, long submerged endurance; secondly, high submerged speed; and thirdly, improved fire control."—** REAR ADM. C. B. MOMSEN ***in "Submarines in 1963," published in the March-April 1953 issue of*** ORDNANCE.

When such tactics are employed, sonar is placed at a tremendous disadvantage. The speed at which its own ship must travel during the urgent attack creates noise. This noise is picked up by the sonar and since this noise probably overrides the sonar signal, accuracies are likely to fall off, and the probability of a kill becomes lower.

That is one reason why a convoy is so vulnerable to submarine attack, especially when the enemy possesses large numbers of submarines. And, lest it be forgot, this was the situation during the early part of World War II.

The Killer Submarine

Discussion of the work of sonar and the part it plays in undersea warfare has thus far been confined to surface-ship applications. There is still another and more vicious form this type of war takes. Reference here is made to the antisubmarine submarine, which is also called the killer submarine.

Sonar in this killer craft assumes a somewhat different aspect than it does in the surface ship. This other type is the passive sonar. It generates no sound, but merely listens and depends upon sounds emitted from other sources for the information it gathers.

Such equipment need not, and generally is not, as complicated as the active sonar. It is effective, however, and the type most depended upon by undersea craft.

The very nature of a submarine and its tactical concept precludes the use of any noise-making device on board. Quiet and stealth are its stock in trade, and considerable effort and funds are spent each year in making the submersible more and more quiet.

Quite apart from the attack enemy submarines might launch upon shipping is the possible danger of attack upon our cities on or near the coast. It has been publicized elsewhere that our submarines are capable of launching guided missiles. We must assume that the enemy is just as capable in this area of technology as we are.

It would be folly to assume otherwise. The history of London's bombardment by this type of destruction launched by the Nazis from Holland during the last war should remain forever fresh in our memories. Furthermore, atomic warheads must now be reckoned with.

Sonar Remains

Our defense against such mode of warfare, when reduced to its simplest terms, consists of making an estimate relative to the maximum distance from which the enemy could launch such an attack and keeping him outside that zone of operation. Chances are remote that an enemy submarine with any such intent would be surfaced for any length of time. This premise alone reduces greatly the possibility of surface or air detection. Little choice, in the method of detection, remains—again, it is sonar.

Versatile though it is, sonar does have its limitations. Ranges at which this equipment would be called upon for detection of guided-missile-launching submarines, are far beyond its capabilities today. Nevertheless, the problem is under vigorous attack.

Some Failures

New requirements for sonar are generated frequently, and an attempt is made to meet each one. However, success is not always attained and then seldom by an easy route. Limitations with respect to funds, technological advances, and available technical personnel occasionally presage failure to achieve the desirable.

What new requirements may arise in the future is open to conjecture at best. A great deal depends upon the development of new weapons and what technological break-throughs may be accomplished.

The opinions or assertions contained herein are those of the author and are not to be construed as official or reflecting the views of the Navy Department or naval service at large.

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SEPTEMBER-OCTOBER, 1953

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Accurate Field Testing of X-Band Radars

WITH MICROLINE* TEST SET AND RANGE CALIBRATOR

Included in Sperry's complete line of Microline instruments are the 38A Test Set (TS 147B/UP) and the AN/UPM-11 Range Calibrator for the accurate testing of X-band radars. These equipments, of rugged design for field usage, can also be employed in laboratory and production testing.

MODEL 38A Test Set (TS 147B/UP)

This portable test set is suitable for measurements on all radar, beacon or missile systems in the 8500-9600 mc. range. It supplies microwave signals of known frequency and power, either continuous wave, frequency modulated or externally modulated. It also measures the power and frequency of external signals in the above frequency range. Model 38A contains a direct reading frequency meter, wattmeter and signal generator which allow the measurement of power and frequency of radar transmitters as well as receiver sensitivity, bandwidth, recovery time and AFC action. Tuning of the frequency meter is accomplished with both a direct and a 5 to 1 reduced drive mechanism for ease of determining narrow pulsed signals as short as 0.2 microseconds.

SPECIFICATIONS:

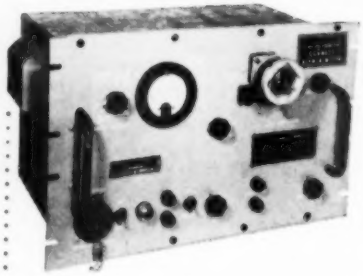
R-F Power Output: Adjustable from −7 to −85 dbm (decibels relative to one milliwatt).

R-F Power Input: From +7 to +30 dbm.

Accuracy: ±1.5db. A calibration chart is supplied.

Frequency Meter Accuracy: ±2.5 mc. absolute at 25°C and 60% RH. Calibration point 9310 ± 1.0 mc.

Our nearest district office will be happy to supply further information on these and other Microline instruments.



MODEL AN/UPM-11 RANGE CALIBRATOR

This instrument is used to test X-band fire-control radars which operate in the 8500-9600 mc. frequency band. It receives microwave signals from a radar and responds with accurately spaced pulses thereby providing a means of calibrating the radar range. It can also be used to boresight the antenna axis of any X-band radar system.

SPECIFICATIONS:

Range Markers: 200 to 50,000 yds. depending on delay line

Accuracy: ± 5 yards

Repeatability of readings (same radar system): ± 1 yard

Tuning: Manual or AFC

* T. M. REG. U. S. PAT. OFF.

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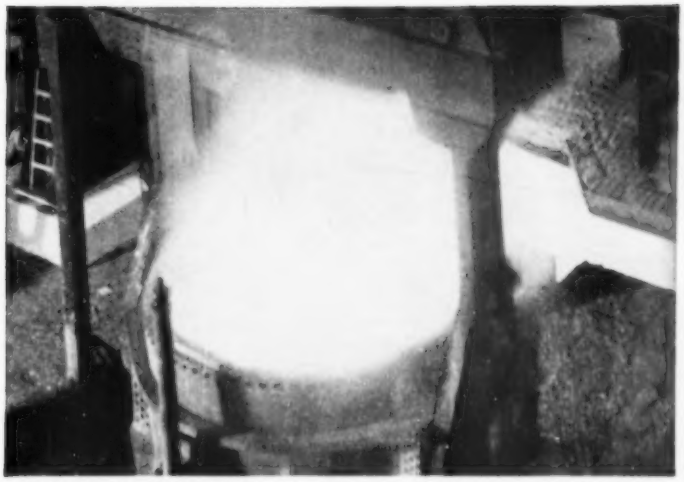

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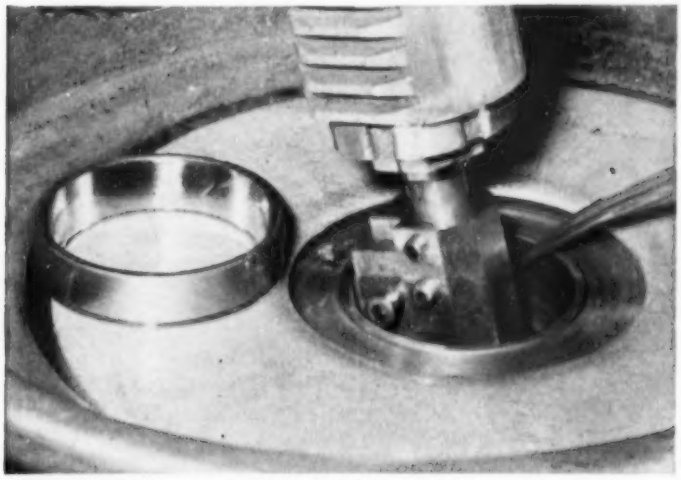

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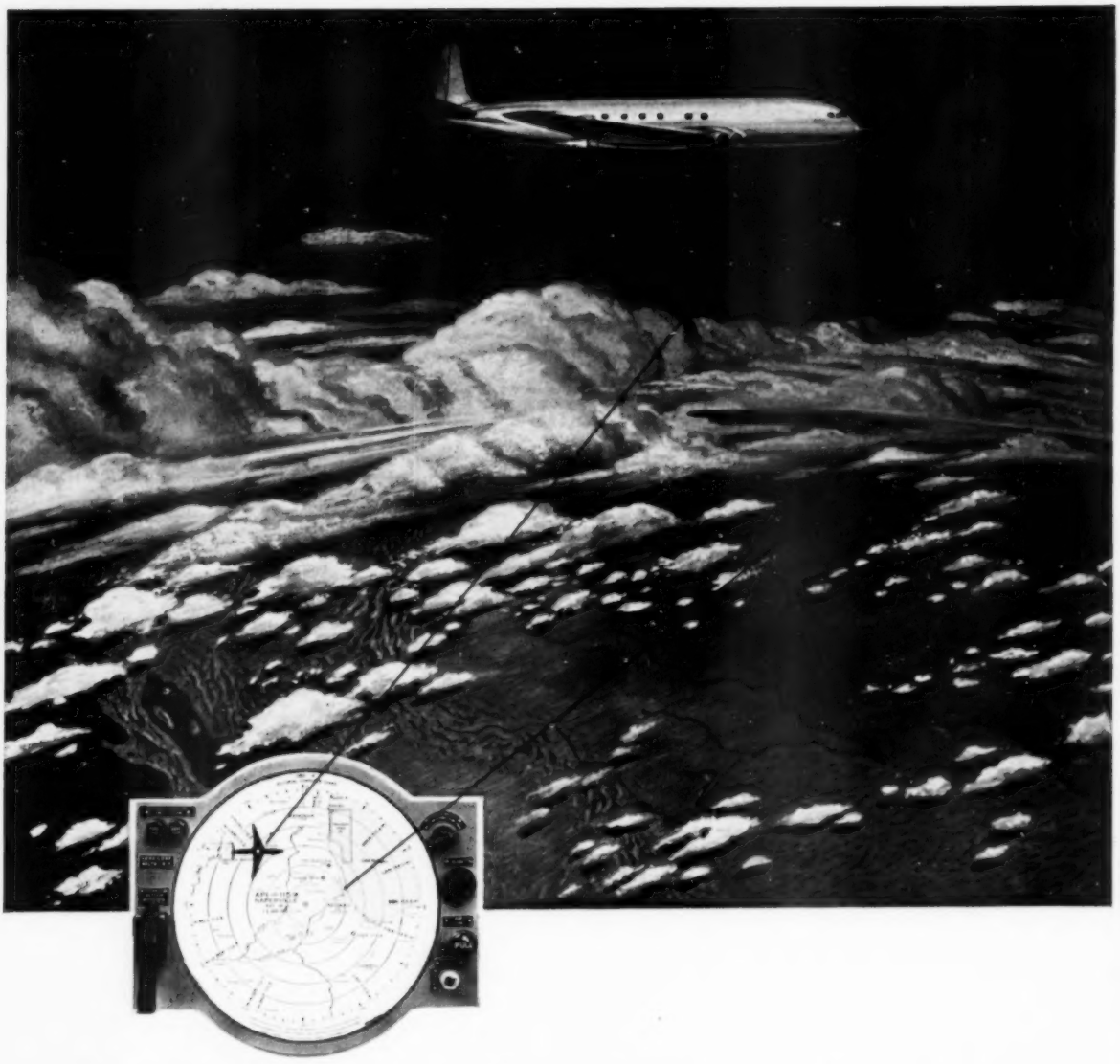

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